

AEROSPACE MEDICINE AND BIOLOGY

A CONTINUING BIBLIOGRAPHY WITH INDEXES



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AEROSPACE MEDICINE AND BIOLOGY

A CONTINUING BIBLIOGRAPHY WITH INDEXES



National Aeronautics and Space Administration
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INTRODUCTION

This issue of *Aerospace Medicine and Biology* (NASA SP-7011) lists 248 reports, articles and other documents originally announced in August 1992 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. The first issue of *Aerospace Medicine and Biology* was published in July 1964.

Accession numbers cited in this issue are:

STAR (N-10000 Series)	N92-24071 — N92-26170
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In its subject coverage, *Aerospace Medicine and Biology* concentrates on the biological, physiological, psychological, and environmental effects to which humans are subjected during and following simulated or actual flight in the Earth's atmosphere or in interplanetary space. References describing similar effects on biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. Applied research receives the most emphasis, but references to fundamental studies and theoretical principles related to experimental development also qualify for inclusion.

Each entry in the publication consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged by *STAR* categories 51 through 55, the Life Sciences division. The citations include the original accession numbers from the respective announcement journals.

Seven indexes—subject, personal author, corporate source, foreign technology, contract, report number, and accession number—are included.

A cumulative index for 1992 will be published in early 1993.

Information on availability of documents listed, addresses of organizations, and NTIS price schedules are located at the back of this issue.

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TYPICAL REPORT CITATION AND ABSTRACT

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ACCESSION NUMBER → **N92-11637*** # Vanderbilt Univ., Nashville, TN. Dept. of Electrical Engineering. ← CORPORATE SOURCE

TITLE → **ROBOT GRAPHIC SIMULATION TESTBED Final Report**

AUTHORS → **GEORGE E. COOK, JANOS SZTIPANOVITS, CSABA BIEGL, GABOR KARSAI, and JAMES F. SPRINGFIELD** Aug. 1991 ← PUBLICATION DATE

CONTRACT NUMBER → (Contract NAG8-690)

REPORT NUMBERS → (NASA-CR-188998; NAS 1.26:188998) Avail: NTIS HC/MF A06; ← AVAILABILITY SOURCE

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The objective of this research was twofold. First, the basic capabilities of ROBOSIM (graphical simulation system) were improved and extended by taking advantage of advanced graphic workstation technology and artificial intelligence programming techniques. Second, the scope of the graphic simulation testbed was extended to include general problems of Space Station automation. Hardware support for 3-D graphics and high processing performance make high resolution solid modeling, collision detection, and simulation of structural dynamics computationally feasible. The Space Station is a complex system with many interacting subsystems. Design and testing of automation concepts demand modeling of the affected processes, their interactions, and that of the proposed control systems. The automation testbed was designed to facilitate studies in Space Station automation concepts.

Author

TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT

ACCESSION NUMBER → **A92-10353**

TITLE → **EFFECTS OF HYPOXIA AND COLD ACCLIMATION ON THERMOREGULATION IN THE RAT**

AUTHORS → **H. GAUTIER, M. BONORA, S. B. M'BAREK, and J. D. SINCLAIR** (Paris VI, Universite, France; Auckland, University, New Zealand) ← AUTHORS' AFFILIATION

JOURNAL TITLE → **Journal of Applied Physiology** (ISSN 0161-7567), vol. 71, Oct. 1991, p. 1355-1363. Research supported by Institut National de la Sante et de la Recherche Medicale. refs ← PUBLICATION DATE

Copyright

Results are reported from an experimental study tracing the effects of hypoxia on thermoregulation and on the different sources of thermogenesis in rats before and after periods of 1-4 wk of cold acclimation. Measurements of the metabolic rate (VO₂) and body temperature (T_b) were made at 5-min intervals, and shivering activity was recorded continuously in groups of rats subjected to three protocols. Recordings were made in normoxia and in hypoxia on different days in the same animals. The results show that: (1) in noncold-acclimated (NCA) rats, cold exposure induced increases in VO₂ and shivering that were proportional to the decrease in T_a; (2) in cold-acclimated (CA) rats in normoxia, for a given ambient temperature, VO₂ and T_b were higher than in NCA rats, whereas shivering was generally lower; and (3) in both NCA and CA rats, hypoxia induced a transient decrease in shivering and a sustained decrease in nonshivering thermogenesis associated with a marked decrease in T_b that was about the same in NCA and CA rats. It is concluded that hypoxia acts on T_b control to produce a general inhibition of thermogenesis.

P.D.

AEROSPACE MEDICINE AND BIOLOGY

A Continuing Bibliography (Suppl. 366)

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LIFE SCIENCES (GENERAL)

A92-36534

THE EFFECT OF HELIOGEOPHYSICAL FACTORS ON AN ORGANISM - STATISTICS OF TRANSPORT INCIDENTS AND THE PROBLEM OF THEIR PREDICTION [VLIYANIE GELIOGEOFIZICHESKIKH FAKTOROV NA ORGANIZM - STATISTIKA TRANSPORTNYKH PROISSHESTVII I PROBLEMA PROGNOZIROVANIYA]

P. V. VASILIK and A. K. GALITSKII (AN Ukrayna, Institut Kibernetiki, Kiev, Ukraine) *Kibernetika i Vychislitel'naya Tekhnika* (ISSN 0454-9910), no. 90, 1991, p. 8-11. In Russian. refs Copyright

Data obtained on the statistics of automotive, air-transport, and railroad incidents and on work-related accidents are analyzed and related to the dynamics of heliogeophysical phenomena recorded for the same time periods. It is found that maxima in the occurrence of transport-related incidents and accidents are correlated with the occurrences of heliogeophysical disturbances, in particular, with abrupt declines in the level of the cosmic-ray neutron component. In view of the fact that heliogeophysical disturbances are known to affect the physiological parameters of animals, it is suggested that observations on animals may be used for predicting increases in the occurrence of accidents in industry and on the roads. The correlations between heliogeophysical disturbances and accidents may be also used for the development of predictive models. I.S.

A92-36595

BASIC CHARACTERISTICS OF LOW-FREQUENCY ELECTROMAGNETOBIOLOGY [OSNOVNYE ZAKONOMERNOSTI NIZKOCHESTOTNOI ELEKTROMAGNITOBIOLOGII]

GENNADII F. PLEKHANOV Tomsk, Russia, Izdatel'stvo Tomskogo Universiteta, 1990, 188 p. In Russian. refs (ISBN 5-7511-0075-1) Copyright

The book reviews results of 30 years of studies on the biological effects of low-frequency electromagnetic radiation and compares these results with literature data obtained in other laboratories. Results are presented on the effect of an electromagnetic field (EMF) on psychophysiological reactions of humans and animals and on the development and the behavior of insects, microorganisms, and isolated cells. An analysis of available data was used to formulate basic laws governing the biological effects of static and low-frequency EMFs and to calculate the relationship between the mean values of the response reactions of these biosystems to EMF. I.S.

A92-36599

ROLE OF OPIOID PEPTIDES IN THE REGULATION OF HEMOPOIESIS [ROL' OPIOIDNYKH PEPTIDOV V REGULIATSII GEMOPOEZII]

EVGENII D. GOL'DBERG, ALEKSANDR M. DYGAII, and OL'GA IU. ZAKHAROVA Tomsk, Russia, Izdatel'stvo Tomskogo

Universiteta, 1990, 140 p. In Russian. refs (ISBN 5-7511-0103-0) Copyright

The book presents a summary of recent literature data concerning the effects of endogenous opioids on the adaptability of a human organism in normal conditions and under extreme stress. Consideration is given to the characteristics of opioid peptides, their role in the formation of adaptive reactions of the organism, and their effects on the hemopoietic system. Particular attention is given to the role of the opioid-receptor ligands in the regulation of hemopoiesis under normal and stressful conditions and the relationships between the opioid mechanisms of the hemopoiesis regulation and the hemopoiesis-inducing environment and regulatory systems such as the nervous, hypophyseal-adrenal, and immune systems. I.S.

A92-36610

ROLE OF GRAVITY IN GROWTH PROCESSES OF PLANTS [SILA TIAZHESTI V PROTSESSAKH ROSTA RASTENII]

AL'FONSAS I. MERKIS (AN Litvy, Institut Botaniki, Vilnius, Lithuania) Moscow, Izdatel'stvo Nauka (Problemy Kosmicheskoi Biologii. Vol. 68), 1990, 184 p. In Russian. refs (ISBN 5-02-004731-7) Copyright

Data collected from the literature and the results of experimental investigations in the author's laboratory concerning the effect of gravity on the growth of plants are summarized. Attention is given to the origin of gravitropic reactions in plant stems and roots and to the methodology used in studies of the effect of gravity on the growth and orientation of plants. Particular consideration is given to studies on the growth and development of plants as well as cultured cells and plant tissues under high and low gravity forces. I.S.

A92-37172

COCHLEAR DEGENERATION IN GUINEA PIGS AFTER REPEATED HYPERBARIC EXPOSURES

X.-Y. ZHENG (2nd Military Medical University; Naval Medical Research Institute, Shanghai, People's Republic of China) and J.-H. GONG (Naval Medical Research Institute, Shanghai, People's Republic of China) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 63, no. 5, May 1992, p. 360-363. refs Copyright

The effects of repeated hyperbaric exposures on inner ear function and morphology in guinea pigs were investigated with auditory electrophysiological testing, histopathological and electron microscopic techniques associated with enzyme histochemical method. The results showed that repeated hyperbaric exposures, though considered 'safe', did cause damage to the cochlear system. Possible causes of the pathology include direct effects of repeated compression and decompression on the ear, and the possibility of inner ear decompression sickness and barotrauma cannot be excluded. Author

A92-37783* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

LIFE IN SPACE

JOHN B. WEST (California, University, La Jolla) *Journal of Applied Physiology* (ISSN 8750-7587), vol. 72, no. 5, May 1992, p. 1623-1630. refs (Contract NAG2-616) Copyright

51 LIFE SCIENCES (GENERAL)

The scope of space life sciences and current research on the physiology of man in space are reviewed by examining Spacelab SLS-1. Milestones of space life sciences are discussed, with emphasis on the Skylab facility, the Space Shuttle program, and the Soviet Mir space station. Attention is given to the topic of the origins of life as it relates to space life sciences. The discovery of amino acids in meteorites and the question of whether the earth was seeded with life from space are discussed. A brief overview of efforts in the search for extraterrestrial intelligence is presented. Consideration is also given to the effects of gravity on cells, the effects of radiation, plant biology, CELSS, and the effects of gravity on humans. C.A.B.

A92-37784

CA(2+) MOVEMENTS IN SARCOPLASMIC RETICULUM OF RAT SOLEUS FIBERS AFTER HINDLIMB SUSPENSION

L. STEVENS and Y. MOUNIER (Lille I, Universite, Villeneuve-d'Ascq, France) *Journal of Applied Physiology* (ISSN 8750-7587), vol. 72, no. 5, May 1992, p. 1735-1740. Research supported by CNES. refs

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Results are presented of an investigation of the functional capacity of skeletal muscle sarcoplasmic reticulum (SR) in the slow soleus of rats submitted to 15 d of disuse produced by hindlimb suspension (HS). Caffeine-induced contractions of single skinned fibers are used to examine Ca(2+) uptake, Ca(2+) release, and passive Ca(2+) leakage through the SR membrane. In the SR of atrophied muscles, the amounts of Ca(2+) uptake and Ca(2+) release were significantly higher than in the control muscles and were close to those found for a fast muscle, the plantaris. It is shown that the time required to empty the SR previously loaded with Ca(2+) was reduced by a factor of two after HS. Such disturbances of the Ca(2+) movements in the SR suggested that alterations of the SR membrane occurred after HS. The results support the idea that after hindlimb unweighting the slow soleus muscle acquired SR properties that were very much like those of a faster muscle. C.A.B.

A92-37785

EFFECTS OF ACID-BASE STATUS ON ACUTE HYPOXIC PULMONARY VASOCONSTRICTION AND GAS EXCHANGE

J. A. LOEPKY, P. SCOTTO, C. E. RIEDEL, R. C. ROACH, and T. W. CHICK (Lovelace Medical Foundation, Albuquerque, NM) *Journal of Applied Physiology* (ISSN 8750-7587), vol. 72, no. 5, May 1992, p. 1787-1797. refs

Copyright

Pulmonary gas exchange and pulmonary hemodynamic responses were measured in anesthetized, paralyzed, and mechanically ventilated dogs in two sets of experiments in order to investigate the relationship between hypoxic pulmonary vasoconstriction and respiratory and metabolic acidosis and respiratory alkalosis. Multiple regression analysis indicated that mean pulmonary arterial pressure (Ppa) was significantly correlated with end-tidal Po₂, mixed venous Po₂, and the mean pulmonary capillary pH as independent variables. C.A.B.

A92-38102* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.

SOYBEAN STEM GROWTH UNDER HIGH-PRESSURE SODIUM WITH SUPPLEMENTAL BLUE LIGHTING

R. M. WHEELER (NASA, Kennedy Space Center, Cocoa Beach, FL), C. L. MACKOWIAK (Bionetics Corp., Cocoa Beach, FL), and J. C. SAGER (NASA, Kennedy Space Center, Cocoa Beach, FL) *Agronomy Journal* (ISSN 0002-1962), vol. 83, no. 5, Sept.-Oct. 1991, p. 903-906. refs

Copyright

To study high-pressure sodium (HPS) lamps used for plant lighting because of their high energy conversion efficiencies, 'McCall' soybean plants were grown for 28 days in growth chambers utilizing HPS lamps, with/without supplemental light from blue phosphor fluorescent lamps. Total photosynthetic photon flux levels, including blue fluorescent, were maintained near 300 or 500 micromol/sq m s. Results indicate that employment of HPS

or other blue-deficient sources for lighting at low to moderate photosynthetic photon flux levels may cause abnormal stem elongation, but this can be prevented by the addition of a small amount of supplemental blue light. R.E.P.

A92-38103* National Aeronautics and Space Administration, Washington, DC.

GRAVITROPISM IN HIGHER PLANT SHOOTS. I - A ROLE FOR ETHYLENE

RAYMOND M. WHEELER and FRANK B. SALISBURY (Utah State University, Logan) *Plant Physiology* (ISSN 0032-0889), vol. 67, 1981, p. 686-690. Research supported by Utah State University. refs

(Contract NSG-7567)

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Two inhibitors of ethylene synthesis, Co(2+) and aminoethoxyvinylglycine (AVG), and two inhibitors of ethylene action, Ag(+) and CO₂, are shown to delay the gravitropic response of cocklebur (*Xanthium strumarium* L.), tomato (*Lycopersicon esculentum* Mill.), and castor bean (*Ricinus communis* L.) stems. Gentle shaking on a mechanical shaker does not inhibit the gravitropic response, but vigorous hand shaking for 120 seconds delays the response somewhat. AVG and Ag(+) further delay the response of mechanically stimulated plants. AVG retards the storage of bending energy but not of stimulus. In gravitropism, graviperception may first stimulate ethylene evolution, which may then influence bending directly, or responses involving ethylene could be more indirect. Author

A92-38104* National Aeronautics and Space Administration, Washington, DC.

GRAVITROPISM IN HIGHER PLANT SHOOTS. IV - FURTHER STUDIES ON PARTICIPATION OF ETHYLENE

RAYMOND M. WHEELER, ROSEMARY G. WHITE, and FRANK B. SALISBURY (Utah State University, Logan) *Plant Physiology* (ISSN 0032-0889), vol. 82, 1986, p. 534-542. Research supported by Utah State University. refs

(Contract NSG-7567)

Copyright

Various hypotheses regarding the influence of ethylene on gravitropism in higher plant shoots were experimentally tested. It was found that ethylene at 1.0 and 10.0 cu cm/cu m decreased the rate of gravitropic bending in cocklebur stems, while 0.1 cu cm/cu m of ethylene had little effect. Treating cocklebur plants with 1.0 mmol aminoethoxyvinylglycine (AVG, an ethylene synthesis inhibitor) delayed stem bending compared with controls, but adding 0.1 cu cm/cu m ethylene in the surrounding atmosphere partially restored the rate of bending of AVG-treated plants. Virtually all newly synthesized ethylene appeared in bottom halves of horizontal stems, where ethylene concentrations were as much as 100 times those in upright stems or in top halves of horizontal stems. Auxin applied to one side of a vertical stem caused extreme bending away from that side; gibberellic acid, kinetin, and abscisic acid were without effect. C.D.

A92-38105* National Aeronautics and Space Administration, Washington, DC.

INTERPRETING PLANT RESPONSES TO CLINOSTATING. I - MECHANICAL STRESSES AND ETHYLENE

FRANK B. SALISBURY and RAYMOND M. WHEELER (Utah State University, Logan) *Plant Physiology* (ISSN 0032-0889), vol. 67, 1981, p. 677-685. Research supported by Utah State University. refs

(Contract NSG-7567)

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The possibility that the clinostat mechanical stresses (leaf flopping) induces ethylene production and, thus, the development of epinasty was tested by stressing vertical plants by constant gentle horizontal or vertical shaking or by a quick back-and-forth rotation (twisting). Clinostat leaf flopping was closely approximated by turning plants so that their stems were horizontal, rotating them quickly about the stem axis, and returning them to the vertical, with the treatment repeated every four minutes. It was found that

horizontal and vertical shaking, twisting, intermittent horizontal rotating, and gentle hand shaking failed to induce epinasties that approached those observed on the slow clinostat. Minor epinasties were generated by vigorous hand-shaking (120 sec/day) and by daily application of Ag(+). Reducing leaf displacements by inverting plants did not significantly reduce the minor epinasty generated by vigorous hand-shaking. I.S.

A92-38108 National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

DEXAMETHASONE EFFECTS ON CREATINE KINASE ACTIVITY AND INSULIN-LIKE GROWTH FACTOR RECEPTORS IN CULTURED MUSCLE CELLS

PEGGY A. WHITSON (NASA, Johnson Space Center, Houston, TX), CHARLES A. STUART (Texas, University, Galveston), M. H. HULS, CLARENCE F. SAMS, and NITZA M. CINTRON (NASA, Johnson Space Center, Houston, TX) *Journal of Cellular Physiology* (ISSN 0021-9541), vol. 140, 1989, p. 8-17. Research supported by NASA. refs

(Contract NAG9-172)

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The effect of dexamethasone on the activity of creatine kinase (CK) and the insulin-like growth factor I (IGF-I) binding were investigated using skeletal- and cardiac-muscle-derived cultured cell lines (mouse, C2C12; rat, L6 and H9c2). It was found that, in skeletal muscle cells, dexamethasone treatment during differentiation of skeletal-muscle cells caused dose-dependent increases in CK activity and increases in the degree of myotube formation, whereas cardiac cells (H9c2) exhibited very low CK activity during culture or dexamethasone treatment. Results for IGF-I binding were similar in all three cell lines. The IGF-I binding to dexamethasone-treated cells (50 nM for 24 hr on the day prior to confluence) resulted in an increased number of available binding sites, with no effect on the binding affinities. I.S.

A92-38109 National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

CHARACTERIZATION OF ATRIAL NATRIURETIC PEPTIDE RECEPTORS IN BRAIN MICROVESSEL ENDOTHELIAL CELLS

PEGGY A. WHITSON (NASA, Johnson Space Center, Houston, TX), M. H. HULS (Krug International, Houston, TX), and CLARENCE F. SAMS (NASA, Johnson Space Center, Houston, TX) *Journal of Cellular Physiology* (ISSN 0021-9541), vol. 146, 1989, p. 43-51. Research supported by NASA. refs

Copyright

In view of the suggestions by Chabrier et al. (1987) and Steardo and Nathanson (1987) that atrial natriuretic peptide (ANP) may play a role in the fluid homeostasis of the brain, the ANP receptors in primary cultures of bovine brain microvessel endothelial cells were quantitated and characterized. Results of partition binding studies and the effect of cGMP additions indicated the presence of at least two types of ANP receptors, with the majority of the receptors being the nonguanlylate cyclase coupled receptors. The presence of at least two ANP receptor types suggests an active role for ANP in regulating brain endothelial cell function. I.S.

A92-38112* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

REDUCED ENERGY INTAKE AND MODERATE EXERCISE REDUCE MAMMARY TUMOR INCIDENCE IN VIRGIN FEMALE BALB/C MICE TREATED WITH

7,12-DIMETHYLBENZ(A)ANTHRACENE

HELEN W. LANE (NASA, Johnson Space Center, Houston, TX; Auburn University, AL), PATRICIA TEER, ROBERT E. KEITH, MARGUERITE T. WHITE, and SUSAN STRAHAN (Auburn University, AL) *Journal of Nutrition* (ISSN 0022-3166), vol. 121, no. 11, Nov. 1991, p. 1883-1888. Research supported by American Institute for Cancer Research. refs

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The concurrent effects of diet (standard AIN-76A, restricted AIN-76A and high-fat diet) and moderate rotating-drum treadmill exercise on the incidence of 7,12-dimethylbenz(a)anthracene-induced mammary carcinomas in virgin female BALB/cMed mice

free of murine mammary tumor virus are evaluated. Analyses show that, although energy intake was related to mammary tumor incidence, neither body weight nor dietary fat predicted tumor incidence. R.E.P.

A92-38113* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

EFFECT OF CHEMICAL FORM OF SELENIUM ON TISSUE GLUTATHIONE PEROXIDASE ACTIVITY IN DEVELOPING RATS

HELEN W. LANE (NASA, Johnson Space Center, Houston, TX; Auburn University, AL), RALPH STRENGTH, JANET JOHNSON, and MARGUERITE T. WHITE (Auburn University, AL) *Journal of Nutrition* (ISSN 0022-3166), vol. 120, no. 1, Jan. 1991, p. 80-86. Research supported by American Institute for Cancer Research. refs

Copyright

The hypothesis that the stage of development of rats may affect the availability of various forms of selenium for the activity of glutathione peroxidase (GSHPx) in the rat was experimentally investigated. One experiment evaluated the availability of selenium as selenite or selenomethionine for GSHPx activity during three developmental states in rats: fetus and 7-day old and 14-day old nursing pups. In all tissues studied, GSHPx activity was highest in the 14-day-old pups whose dams were in the selenomethionine group. Rat pups given intraperitoneal selenite had higher liver and kidney GSHPx activity than pups given the same amount of selenium as intraperitoneal selenomethionine. In a second experiment, all dams were fed the same basal diet and pups were weaned to diets containing one of two levels of selenium and one of three forms of selenium (selenite, selenomethionine, or selenocystine). The results also supported the hypothesis these dietary forms of selenium are differentially available for GSHPx activity. C.D.

A92-38114* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

THE EFFECT OF DIET, EXERCISE, AND 7,12-DIMETHYLBENZ(A)ANTHRACENE ON FOOD INTAKE, BODY COMPOSITION, AND CARCASS ENERGY LEVELS IN VIRGIN FEMALE BALB/C MICE

HELEN W. LANE (NASA, Johnson Space Center, Houston, TX; Auburn University, AL), ROBERT E. KEITH, SUSAN STRAHAN, and MARGUERITE T. WHITE (Auburn University, AL) *Journal of Nutrition* (ISSN 0022-3166), vol. 121, no. 11, Nov. 1991, p. 1876-1882. Research supported by American Institute for Cancer Research. refs

Copyright

The effects of diet, exercise, and 7,12-dimethylbenz(a)anthracene (DMBA), a mammary-tumor carcinogen, on food intake, energy consumption, body weight, and body composition in virgin female BALB/c mice are investigated. Diet, exercise, and DMBA all had pronounced effects on energy consumption, which in turn affected body composition. These treatments may influence manifestations of breast cancer via their effects on body composition. P.D.

A92-38116 National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

HYPERGRAVITY SIGNAL TRANSDUCTION IN HELA CELLS WITH CONCOMITANT PHOSPHORYLATION OF PROTEINS IMMUNOPRECIPITATED WITH

ANTI-MICROTUBULE-ASSOCIATED PROTEIN ANTIBODIES

YASUHIRO KUMEI (Tokyo Medical and Dental University, Japan), PEGGY A. WHITSON (NASA, Johnson Space Center, Houston, TX), ATSUSHIGE SATO (Tokyo Medical and Dental University, Japan), and NITZA M. CINTRON (NASA, Johnson Space Center, Houston, TX) *Experimental Cell Research* (ISSN 0014-4827), vol. 192, 1991, p. 492-496. Research supported by NASA. refs

Copyright

It is shown that hypergravity (35g) stimulates the production of inositol 1,4,5-trisphosphate (IP3) and decreases adenosine 3-prime,5-prime-cyclic monophosphate (cAMP) levels in HeLa cells.

It is proposed that IP3 and cAMP may act as second messengers in hypergravity signal transduction. Phosphorylation of microtubule-associated proteins in both the detergent-soluble and -insoluble fractions suggests that cytoskeletal structures may be influenced by gravity. P.D.

A92-38118 National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

IMMUNOREACTIVE PROHORMONE ATRIAL NATRIURETIC PEPTIDES 1-30 AND 31-67 - EXISTENCE OF A SINGLE CIRCULATING AMINO-TERMINAL PEPTIDE

YU-MING CHEN (Krug International, Houston, TX), PEGGY A. WHITSON, and NITZA M. CINTRON (NASA, Johnson Space Center, Houston, TX) Biochemical and Biophysical Research Communications (ISSN 0006-291X), vol. 166, no. 2, Jan. 30, 1990, p. 794-800. Research supported by NASA. refs Copyright

Sep-Pak C18 extraction of human plasma and radioimmunoassay using antibodies which recognize atrial natriuretic peptide (99-128) and the prohormone sequences 1-30 and 31-67 resulted in mean values from 20 normal subjects of 26.2 (+/- 9.2), 362 (+/- 173) and 368 (+/- 160) pg/ml, respectively. A high correlation coefficient between values obtained using antibodies recognizing prohormone sequences 1-30 and 31-67 was observed ($R = 0.84$). Extracted plasma immunoreactivity of 1-30 and 31-67 both eluted at 46 percent acetonitrile. In contrast, chromatographic elution of synthetic peptides 1-30 and 31-67 was observed at 48 and 39 percent acetonitrile, respectively. Data suggest that the radioimmunoassay of plasma using antibodies recognizing prohormone sequences 1-30 and 31-67 may represent the measurement of a unique larger amino-terminal peptide fragment containing antigenic sites recognized by both antisera.

Author

A92-38119* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

LONG-TERM STORAGE OF SALIVARY CORTISOL SAMPLES AT ROOM TEMPERATURE

YU-MING CHEN (Krug International, Houston, TX), NITZA M. CINTRON, and PEGGY A. WHITSON (NASA, Johnson Space Center, Houston, TX) Clinical Chemistry (ISSN 0009-9147), vol. 38, no. 2, 1992, p. 304. refs Copyright

Collection of saliva samples for the measurement of cortisol during space flights provides a simple technique for studying changes in adrenal function due to microgravity. In the present work, several methods for preserving saliva cortisol at room temperature were investigated using radioimmunoassays for determining cortisol in saliva samples collected on a saliva-collection device called Salivettes. It was found that a pretreatment of Salivettes with citric acid resulted in preserving more than 85 percent of the salivary cortisol for as long as six weeks. The results correlated well with those for a sample stored in a freezer on an untreated Salivette. I.S.

A92-38169* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.

DEVELOPING FUTURE PLANT EXPERIMENTS FOR SPACEFLIGHT

T. W. DRESCHER, C. S. BROWN, C. R. HINKLE (Bionetics Corp., Cocoa Beach, FL), J. C. SAGER, and W. M. KNOTT (NASA, Kennedy Space Center, Cocoa Beach, FL) American Society of Agricultural Engineers, International Winter Meeting, Chicago, IL, Dec. 18-21, 1990, Paper. 17 p. refs (Contract NAS10-10285) Copyright

Experiments are described which were designed to support the constructing and using clinostats for studies of microgravity effects and for measuring photosynthesis and respiration in plants in clinostat experiments. Particular attention is given to the development and testing a clinostat for rotating the Space Shuttle Mid-Deck Locker Plant Growth Unit (PGU), a sealed chamber for plan growth and gas exchange measurements on a clinostat, and

a porous tube plant nutrient delivery system for the PGU. Design diagrams of these items are presented together with the results of tests. I.S.

A92-38476*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

SPACELAB LIFE SCIENCES 1 RESULTS

RHEA SEDDON (NASA, Johnson Space Center, Houston, TX) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 5 p.

(AIAA PAPER 92-1270) Copyright

Results are presented from the experiments conducted by the first Shuttle/Spacelab mission dedicated entirely to the life sciences, the Spacelab Life Sciences 1, launched on June 5, 1991. The experiments carried out during the 9-day flight included investigations of changes in the human cardiovascular, pulmonary, renal/endocrine, blood, and vestibular systems that were brought about by microgravity. Results were also obtained from the preflight and postflight complementary experiments performed on rats, which assessed the suitability of rodents as animal models for humans. Most results verified, or expanded on, the accepted theories of adaptation to zero gravity. I.S.

A92-38517*# National Aeronautics and Space Administration, Washington, DC.

THE RATIONALE FOR FUNDAMENTAL RESEARCH IN SPACE BIOLOGY - INTRODUCTION AND BACKGROUND

T. W. HALSTEAD and R. W. KRAUSS (NASA, Washington, DC) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 3 p.

(AIAA PAPER 92-1342) Copyright

An overview is presented of the concept and development of SSF and the unique opportunities offered by SSF to take advantage of the greater space, the increased power, and especially the long duration of the station for a cascade of innovative experiments in fundamental science. It is emphasized that this space environment will provide new dimensions for approaching some of the most challenging problems still facing modern biology.

R.E.P.

A92-38518*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

OPPORTUNITIES AND QUESTIONS FOR THE FUNDAMENTAL BIOLOGICAL SCIENCES IN SPACE

JOSEPH C. SHARP and JOAN VERNIKOS (NASA, Ames Research Center, Moffett Field, CA) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 4 p. refs

(AIAA PAPER 92-1343) Copyright

The nature of biological issues which can be addressed during long-term space missions is briefly discussed. These issues include structure, from cell to organ to organism; function, the regulation of systems such as immunology, neural sciences, and behavior; and reproduction and development. O.G.

A92-38519*# National Aeronautics and Space Administration, Washington, DC.

SPACE RESEARCH WITH INTACT ORGANISMS

ROBERT W. PHILLIPS (NASA, Washington, DC) and FRANCIS J. HADDY (Uniformed Services University of Health Sciences, Bethesda, MD) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 5 p. refs (AIAA PAPER 92-1344)

Effects of space exposure on intact organisms are briefly reviewed, and examples of future experiments that might provide new information on the role of gravity in the evolution of life are suggested. It is noted that long term experiments with intact plant and animals for studying gravitational thresholds will provide important new insights. O.G.

A92-38521#

A SCIENTIFIC ROLE FOR SPACE STATION FREEDOM - RESEARCH AT THE CELLULAR LEVEL

TERRY C. JOHNSON (Kansas State University, Manhattan) and JOHN N. BRADY (NIH, National Cancer Institute, Bethesda, MD) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 9 p. refs (AIAA PAPER 92-1346) Copyright

The scientific importance of Space Station Freedom is discussed in light of the valuable information that can be gained in cellular and development biology with regard to the microgravity environment on the cellular cytoskeleton, cellular responses to extra-cellular signal molecules, morphology, events associated with cell division and cellular physiology. Examples of studies in basic cell biology are presented, as well as their potential importance to concerns for future enabling strategies. Author

A92-38522#

RESEARCH IN MOLECULAR BIOLOGY - REALIZING THE POTENTIAL OF MICROGRAVITY IN BIOLOGICAL SYSTEMS

NORMAN G. LEWIS and CLARENCE A. RYAN (Washington State University, Pullman) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 6 p. refs (AIAA PAPER 92-1347) Copyright

Microgravity effects on plant growth and development in the SSF space environment are discussed. Topics under consideration include identification of genes involved in gravity compensation processes, cell-cell recognition and adhesion, cell wall synthesis, and the spacecraft as a biochemistry/molecular biology laboratory. It is noted that a systematic examination of the effects of gravity on plant growth and development in the absence of gravity, at the gene/biochemical level, will make it possible to identify and design new ways to biotechnologically exploit plant life in a manner hitherto not possible. O.G.

A92-38779

SELF-SPLICING INTRONS IN tRNA GENES OF WIDELY DIVERGENT BACTERIA

BARBARA REINHOLD-HUREK (Ghent, State University, Belgium) and DAVID A. SHUB (New York, State University, Albany) Nature (ISSN 0028-0836), vol. 357, no. 6374, May 14, 1992, p. 173-176. Research supported by NIH and DFG. refs Copyright

The discovery of two small self-splicing group I introns in members of two proteobacterial subgroups, *Agrobacterium tumefaciens* (Alpha) and *Azoarcus* sp. (beta) is described. The introns are inserted in genes for tRNA(Arg) and tRNA(Ile), respectively, after the third anticodon nucleotide. Their occurrence in different genes of phylogenetically diverse bacteria indicates that group I introns have a widespread distribution among eubacteria. C.D.

A92-39126

INTERNATIONAL UNION OF PHYSIOLOGICAL SCIENCES COMMISSION ON GRAVITATIONAL PHYSIOLOGY, ANNUAL MEETING, 12TH, LENINGRAD, USSR, OCT. 14-18, 1990, PROCEEDINGS

ORR E. REYNOLDS, ED. (American Physiological Society, Bethesda, MD) Meeting supported by Galileo Foundation, Universite Lyon I, USAF, et al. Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, 251 p. For individual items see A92-39127 to A92-39215.

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Papers are presented on the topics concerned with current concepts in gravitational physiology; recent spaceflight results in gravitational physiology; gravitational biology on cellular and subcellular levels; general problems in gravitational physiology; metabolism and hormonal regulation; neuromuscular adaptation to gravity; growth, development, and regeneration; biorhythms; circulation; neuromuscular and musculoskeletal physiology; graviception, sensory interaction, and motion sickness; and models, methods, and equipment. Particular attention is given to the current status of acute high-G physiology, the pathogenesis of sensory disorders in microgravity, physiological mechanisms of cell adaptation to microgravitation, and digestive histochemical reactions in rats after space flight of different duration.

Consideration is also given to the age-dependency of sympathetic nerve response to gravity in humans, the hypergravity and development of mammals, studies of circadian rhythms in space flight, and modeling changes in mechanical constraints of left ventricular myocardium under +Gz acceleration. I.S.

A92-39127* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

MICROGRAVITY AND THE LUNG

JOHN B. WEST (California, University, La Jolla) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-8 to S-10. refs

(Contract NAG2-616; NIH-HL-17331-16)

Results are presented from studies of the effect of microgravity on the lungs of rats flown on the Cosmos 2044 mission, and from relevant laboratory experiments. The effects of microgravity fall into five categories: topographical structure and function, the lung volumes and mechanics, the intrathoracic blood pressures and volumes, the pulmonary deposition of aerosol, and denitrogenation during EVA. The ultrastructure of the left lungs of rats flown for 14 days on the Cosmos 2044 spacecraft and that of some tail-suspended rats disclosed presence of red blood cells in the alveolar spaces, indicating that pulmonary hemorrhage and pulmonary edema occurred in these rats. Possible causes for this phenomenon are discussed. I.S.

A92-39129

ANIMAL MOTILITY AND GRAVITY

ROBERT J. FULL (California, University, Berkeley) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-15 to S-18. refs

(Contract NSF DCB-90-58138)

The variables affecting the metabolic cost of motility at 1G and greater are investigated. Results of studies on the effect of the magnitude of the gravity vector on the amount of muscle force production and the rate of force development showed that, if changes in the amount of force produced or in the cost of force production are directly proportional to changes in gravitational acceleration, the specific resistance to locomotion will remain constant. If changes in gravitational acceleration result in a disproportionate decrease of the effective mechanical advantage of limbs or in the reduction in contact time for the developing force, the specific resistance may increase. If changes in gravitational acceleration disproportionately increase the effective mechanical advantage or the contact time for the developing force, then the specific resistance may decrease. I.S.

A92-39131

HYPONORADRENERGIC SYNDROME OF WEIGHTLESSNESS - ITS MANIFESTATIONS IN MAMMALS AND POSSIBLE MECHANISM

I. B. KRASNOV (Institute of Biomedical Problems, Moscow, Russia) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-23 to S-26. refs

The paper examines the mechanism(s) underlying the microgravity-induced hypofunction of pituitary somatotrophs and thyrotrophs, which are the two major causes of the various observable physiological effects of weightlessness. Literature data are presented which suggest a hyponoradrenergic mechanism underlying the hypofunction of the pituitary somatotrophs and thyrotrophs during weightlessness. The following sequence of events is suggested: (1) a decrease during a space flight of the flow of vestibular and proprioceptive impulses to the vestibular nuclei along the vestibular and spinovestibular fibers lowers the

level of impulses from vestibular nuclei to noradrenergic neurons of the locus ceruleus, (2) this event in turn decreases the activating effect of the locus-ceruleus noradrenergic neurons upon pituitary somatotrophs and thyrotrophs. I.S.

A92-39133**FRANCE/UNITED STATES SPACE FACILITY FOR RHESUS EXPERIMENTS**

MICHEL VISO (INRA, Toulouse, France) and MICHEL VENET (CNES, Toulouse, France) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-29 to S-31. refs

The Rhesus Research Facility (RRF) designed for the Rhesus experiment aboard Spacelab is described with special attention given to the Experiment System Orbiting Primate compartments for the two *Macaca mulatta* monkeys (who will stay in space for 16 days) and the related hardware. Particular consideration is given to the details of the environmental conditions control and to the monitoring of the animal health and welfare. The scientific objectives of the Rhesus experiment include studies of the monkeys' behavior and performance and measurements of the parameters of muscle physiology, bone/calcium physiology, immunology/microbiology, cardiopulmonary physiology, regulatory physiology, and neurophysiology. The RRF is designed to fly for the first time in 1995. I.S.

A92-39138**THE MONKEY IN SPACE FLIGHT**

E. A. IL'IN, V. I. KOROL'KOV, I. B. KOZLOVSKAIA, V. I. LOBACHIK, and A. N. TRUZHENNIKOV (Institute of Biomedical Problems, Moscow, Russia) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-49 to S-51.

Results are presented from studies on two primates during their two-week space flights on board Cosmos-1887 and Cosmos-2044, in which quantitative data on the status of the cardiovascular system, conditional reflex activity, body fluids, and metabolism were collected for each subject. It is suggested that changes of some physiological parameters observed after flight in these monkeys should be considered as an adaptive response to the effect of weightlessness. For instance, after the flight, a new level of hydration homeostasis formed, with a lower content of body fluids. I.S.

A92-39139* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

CELLULAR IMMUNITY AND LYMPHOKINE PRODUCTION DURING SPACEFLIGHTS

I. V. KONSTANTINOVA (Institute of Biomedical Problems, Moscow, Russia), G. SONNENFELD (Louisville, University, KY), A. T. LESNIAK (Institute of Biomedical Problems, Moscow, Russia), L. SHAFFAR (Institut National de la Sante et de la Recherche Medicale, Nice, France), A. MANDEL (NASA, Ames Research Center, Moffett Field, CA), M. P. RYKOVA, E. N. ANTROPOVA (Institute of Biomedical Problems, Moscow, Russia), and B. FERRUA (Institut National de la Sante et de la Recherche Medicale, Nice, France) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-52 to S-56. refs

Results are presented on changes in cellular immunity and in the production of lymphokine in spacecrews during spaceflights. Measurements were carried out on blood samples collected from 50 cosmonauts before and after spaceflights of different duration, on board Salyut-6, Salyut-7, or Mir. Additional data were obtained from rats flown on board the Cosmos-1667 and Cosmos-1887 biosatellites. The parameters measured included the PHA responsiveness of T lymphocytes, the activity of T-helper cells

and of nonspecific T suppressors, the activity of the so-called natural killer lymphocytes, the production of gamma-interferon, and the cell-surface markers. Results showed that the frequency and the extent of changes in the immunologic resistance of subjects depended on the duration of the flight. However, even after the most prolonged (365 days) spaceflight, the changes observed were mostly of a functional character with subsequent rapid return to normal. I.S.

A92-39140**CHANGES OF LUMBAR VERTEBRAE AFTER COSMOS-1887 SPACE FLIGHT**

I. FOLDES, T. SZILAGYI, M. RAPCSAK, V. VELKEY (Debrecen University of Medicine, Hungary), and V. S. OGANOV (Institute of Biomedical Problems, Moscow, Russia) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-57, S-58. refs

Results are presented on changes in lumbar vertebrae of rats flown aboard Cosmos-1887 for 12.5 days, which were observed in histological sections and histomorphometric data by a comparison with those collected from ground controls. Results show a decrease in bone formation and an increase of bone destruction, confirming the reports of Zerath et al. (1990) and Kaplansky et al. (1990). It is suggested that the vertebral bone disorders observed in rats flown in space might be related to changes in hormones, particularly the 1.25 (OH)2D3 and PTH. I.S.

A92-39141**EMBRYONIC DEVELOPMENT OF JAPANESE QUAIL UNDER MICROGRAVITY CONDITIONS**

K. BODA (Slovak Academy of Sciences, Institute of Animal Biochemistry and Genetics, Ivanka pri Dunaji, Czechoslovakia), G. I. MELESHKO (Institute of Biomedical Problems, Moscow, Russia), V. SABO (Slovak Academy of Sciences, Institute of Animal Biochemistry and Genetics, Ivanka pri Dunaji, Czechoslovakia), E. IA. SHEPELEV, T. S. GUR'EVA (Institute of Biomedical Problems, Moscow, Russia), M. JURANI, and L. KOSTAL (Slovak Academy of Sciences, Institute of Animal Biochemistry and Genetics, Ivanka pri Dunaji, Czechoslovakia) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-59 to S-61. refs

Results are presented from the Incubator-2 experiment designed for a study of the embryogenesis cycle of quail under conditions of microgravity. The equipment used in the experiment included a special incubator provided with a rearing device for six quails, a driving panel, a vacuum pump for exhausting the excrements, and a feed container. Results indicate that, while the process of embryogenesis developed normally under microgravity, the hatched quails were incapable to adapt their motor activity to microgravity. I.S.

A92-39142**PHYSIOLOGICAL MECHANISMS OF CELL ADAPTATION TO MICROGRAVITATION**

M. G. TAIRBEKOV (Institute of Biomedical Problems, Moscow, Russia) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-62, S-63. refs

An analysis was performed of the results of laboratory and spaceborne experiments designed to study the nature and the regularity of structural and functional intracellular changes occurring in response to microgravity exposures, using as subjects various prokaryotes and eukaryotes, and cells from multicellular organisms. Results indicate that intracellular processes are free of direct influence of microgravity. I.S.

A92-39143**RECEPTOR-LIGAND BINDING ON OSTEOBLASTS IN MICROGRAVITY OBTAINED BY PARABOLIC FLIGHT**

D. A. SCHMITT (CRTS, Laboratoire Histocompatibilité, Strasbourg, France), A. MALOUIER, X. HOLY (Centre d'Enseignement et de Recherche de Médecine Aeronautique, Bretigny-sur-Orge, France), P. J. MARIE (Institut National de la Santé et de la Recherche Médicale, Paris, France), J. C. CAISSARD, and E. ZERATH (Centre d'Enseignement et de Recherche de Médecine Aeronautique, Bretigny-sur-Orge, France) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) *Physiologist, Supplement* (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-64, S-65. Research supported by CNES. refs

The effect of microgravity on the receptor-ligand interaction on cellular surface was studied using cultured rat osteogenic sarcoma (ROS) cells during a parabolic flight experiment aboard the French 'zero-G' Caravelle, where the gravity levels reached $10 \exp -4$ G. Using gold-labeled epidermal growth factor molecules as a ligand, it was found that the receptor-ligand interaction at $10 \exp -4$ G was not different from that at 1 G. No modification of ROS cell morphology due to microgravity was observed. I.S.

A92-39145**CHANGES IN ION CHANNEL PROPERTIES RELATED TO GRAVITY**

RAVEN REITSTETTER, ALBRECHT SCHATZ, ASTRID LINDE-HOMMES, and WOLFGANG BRIEGLEB (DLR, Institut fuer Flugmedizin, Cologne, Federal Republic of Germany) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) *Physiologist, Supplement* (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-68, S-69. refs

The effect of changes in the lipid bilayer arrangement, related to changes in gravity, on the ion channel properties of lipid bilayer membranes was investigated using lipid bilayer membranes of two different orientations, formed from phosphatidylserine dispersed in heptane on a polyethylene support. Horizontal and vertical orientations of bilayer membranes were obtained by using two different kinds of polyethylene support. Single channel currents were directly recorded on hard disk for later evaluation of current amplitudes. Gramicidin channel events were measured for both spatial arrangements in 1 M and 0.1 KCl solutions. A comparison of the current-voltage plots obtained for 1M KCl showed no difference in gramicidin conductance between vertical and horizontal bilayer arrangements. For 0.1 M solutions, the slope for conductance in horizontal membranes was steeper than in the vertical bilayer arrangements. No offset potential was observed. I.S.

A92-39146* National Aeronautics and Space Administration, Washington, DC.

HYDROSTATIC FACTORS AFFECT THE GRAVITY RESPONSES OF ALGAE AND ROOTS

MARK P. STAVES, RANDY WAYNE, and A. C. LEOPOLD (Cornell University, Ithaca, NY) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) *Physiologist, Supplement* (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-70, S-71. Research supported by NASA. refs

The hypothesis of Wayne et al. (1990) that plant cells perceive gravity by sensing a pressure differential between the top and the bottom of the cell was tested by subjecting rice roots and cells of Caracean algae to external solutions of various densities. It was found that increasing the density of the external medium had a profound effect on the polar ratio (PR, the ratio between velocities of the downwardly and upwardly streaming cytoplasm) of the Caracean algae cells. When these cells were placed in solutions of denser compound, the PR decreased to less than 1, as the density of the external medium became higher than that of the cell; thus, the normal gravity-induced polarity was reversed, indicating that the osmotic pressure of the medium affects the cell's ability to respond to gravity. In rice roots, an increase of the

density of the solution inhibited the rate of gravitropism. These results agree with predictions of a hydrostatic model for graviperception. I.S.

A92-39147**AN OVERLOOKED GRAVITY SENSING MECHANISM**

LEONARD F. CIPRIANO (Lockheed Engineering and Sciences Co., Western Programs Office, Moffett Field, CA) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) *Physiologist, Supplement* (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-72 to S-75. refs

Experiments are described which demonstrate the involvement of the cellular cytoskeleton in sensing gravity. E.g., it was found that microtubules formed in vitro during the perigee maneuver of a parabolic flight were more dense than those formed during the apogee maneuver and that gravistimulation increased microtubule density in a growing tip of *Cetadon* culture, while a study on the development of amphibian embryo suggested that the reorganization of the cytoplasm directs the eventual bilateral symmetry and that the cytoskeleton stabilizes the 3D position of the cytoplasmic zones. This paper attempts to reinterpret some former microgravity experiments by assuming that the cytoskeleton is a possible mechanisms of gravity sensing. Results of this review indicate that the cytoskeletal architecture and its influence on the cell membrane or the internal cell environment should be considered as a physiological control element. I.S.

A92-39148* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, CA.

CARTILAGE FORMATION IN THE CELLS 'DOUBLE BUBBLE' HARDWARE

P. J. DUKE, JORGE ARIZPE, and DINA MONTUFAR-SOLIS (Texas, University, Houston) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) *Physiologist, Supplement* (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-76, S-77. refs
(Contract NCC2-423)

The CELLS experiment scheduled to be flown on the first International Microgravity Laboratory is designed to study the effect of microgravity on the cartilage formation, by measuring parameters of growth in a differentiating cartilage cell culture. This paper investigates the conditions for this experiment by studying cartilage differentiation in the 'bubble exchange' hardware with the 'double bubble' design in which the bubbles are joined by a flange which also overlays the gasket. Four types of double bubbles (or double gas permeable membranes) were tested: injection-molded bubbles 0.01- and 0.005-in. thick, and compression molded bubbles 0.015- and 0.01-in. thick. It was found that double bubble membranes of 0.005- and 0.010-in. thickness supported cartilage differentiation, while the 0.015-in. bubbles did not. It was also found that nodule count, used in this study as a parameter, is not the best measure of the amount of cartilage differentiation. I.S.

A92-39149**GRAVITATIONAL BIOLOGY EXPERIMENTS ABOARD THE BIOSATELLITES 'COSMOS NO. 1887 AND NO. 2044**

A. M. ALPATOV, M. G. TAIRBEKOV, and I. A. USHAKOV (Institute of Biomedical Problems, Moscow, Russia) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) *Physiologist, Supplement* (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-78, S-79. refs

The effect of microgravity on the growth dynamics of animal and plant biological systems was investigated using Protozoans, cell cultures, plants, flat worms, and amphibians. It was found that microgravity only slightly stimulated or inhibited some biological processes, but the effects remained within the normal range of biological response. No qualitative unfavorable effects of microgravity were detected. I.S.

A92-39154

PLASMA INSULIN LEVELS AND INSULIN RECEPTORS IN LIVER AND ADIPOSE TISSUE OF RATS AFTER SPACE FLIGHT

L. MACHO, M. FICKOVA, S. ZORAD (Slovak Academy of Sciences, Institute of Experimental Endocrinology, Bratislava, Czechoslovakia), L. SEROVA, and I. POPOVA (Institute of Biomedical Problems, Moscow, Russia) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-90, S-91. refs

The effects of space flights of different duration on the levels of plasma insulin and glucose in rats and on the insulin-binding capacity of specific membrane receptors in liver and adipose tissue were investigated in rats flown on board satellites of the Cosmos series for 7, 13, 18, and 20 days, as well as rats in synchronous model (SM) laboratory experiments. Results showed that rats flown in space and sacrificed 6 to 10 hours after landing had increased levels of plasma insulin, with a maximum occurring at 13 days. Glucose increased slightly after flights of up to 18 days, after which the concentrations fell to or below the control levels. The insulin binding capacity of membranes of fat cells (but not of liver cells) exhibited a sharp increase in rats subjected to 14 days of space flight; no such increase was found in SM rats. I.S.

A92-39155

EFFECT OF LONG-TERM HINDLIMB SUSPENSION ON BLOOD COMPONENTS

MASAYUKI NAKAYA, KAZUO KOSUGI, and SHUJI TAKEUCHI (Jikei University, Tokyo, Japan) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-92, S-93. refs

The effect of microgravity on the contents in blood of various blood components was investigated in rats subjected to 10-week-long tail suspension. Results showed that long-duration tail-suspension resulted in significant decreases in the contents of blood albumin, uric acid, and triglyceride and in increased content of creatine kinase. The anemia observed in tail-suspended rats resembled symptoms of sideroblastic anemia and was different from the type of anemia observed in astronauts. I.S.

A92-39156

PROTEIN COMPOSITION IN HUMAN PLASMA AFTER LONG-TERM ORBITAL MISSIONS AND IN RODENT PLASMA AFTER SPACEFLIGHTS ON BIOSATELLITES 'COSMOS-1887' AND 'COSMOS-2044'

O. N. LARINA (Institute of Biomedical Problems, Moscow, Russia) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-94, S-95. refs

The effect of long-duration spaceflights on the composition of plasma proteins was investigated in two crewmembers of a 367-day mission and in two crewmembers of a 167-day mission aboard the Soyus-Mir complex and in rats flown aboard Cosmos-1887 and Cosmos-2044 biosatellites, using results of 2D electrophoresis. The 2D maps of crewmembers, obtained the day after the recovery, show manifold increases in the contents of several proteins seen normally in trace amounts, as well as the appearance of several unusual protein spots. Rats flown aboard Cosmos-1887 exhibited higher levels of fibrinogen (compared to vivarium controls) two days after landing; however, rats flown on Cosmos-2044 exhibited no difference from controls. It is suggested that the observed abnormalities in plasma proteins could have been caused by gravitational stress applied by return to earth conditions. I.S.

A92-39157

INFLUENCES OF SIMULATED MICROGRAVITY AND HYPERGRAVITY ON THE IMMUNE FUNCTIONS IN ANIMALS

GUANGHUA YANG, SHUQING WANG, and JIN NIAN (Institute of Space Medico-Engineering, Beijing, People's Republic of China) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-96, S-97.

The effects of microgravity and hypergravity on the immune system of rats, mice, and rabbits were investigated, using body suspension, tail suspension, head-down tilt (HDT), and water immersion to simulate microgravity, and centrifugation at +5G and +10 Gz to simulate hypergravity. Changes found in animals exposed to microgravity included atrophy of thymus and spleen and a reduction of serum lysozyme and splenic lymphocyte count. Hypergravity was found to cause increases in splenic lymphocyte counts. I.S.

A92-39159

DIGESTIVE HISTOCHEMICAL REACTIONS IN RATS AFTER SPACE FLIGHT OF DIFFERENT DURATION

P. GROZA, A. BOCA, and A. BORDEIANU (Institute of Physiology, Bucharest, Romania) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-100, S-101. refs

The effect of microgravity exposures for various times on the activities of digestive enzymes and on the digestion products were investigated in rats flown aboard Soviet biosatellites for 5, 7, 13, 14, and 18.5 days, using histochemical techniques. Results of postflight analyses showed that rats flown in space had decreased contents of glycoprotein in sublingual glands and in the gastric and intestinal mucosae, as well as increased activities of leucine aminopeptidase and acid phosphatase in the small intestine. These responses were proportional to the duration of flight. I.S.

A92-39160* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

CHANGES IN RECRUITMENT OF RHESUS SOLEUS AND GASTROCNEMIUS MUSCLES FOLLOWING A 14 DAY SPACEFLIGHT

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(Contract NCC2-535) The effect of microgravity on the recruitment patterns of the soleus, gastrocnemius, and tibialis-anterior muscles was investigated by comparing electromyograms (EMGs) of these muscles of Rhesus monkeys implanted with EMG electrodes, taken before and after a 14-day flight on board Cosmos 2044. It was found that the EMG amplitude values in the soleus muscle decreased after the spaceflight but returned to normal values over the 2-wk recovery period. The medial amplitudes of gastrocnemius and tibialis anterior were not changed by flight. Joint probability density distributions displayed changes after flight in both the soleus and gastrocnemius muscles, but not in tibialis anterior. I.S.

A92-39163

THE ROLE OF CENTRAL NEUROCHEMICAL MECHANISMS IN REGULATION OF POSTURE ADJUSTMENT AND VOLUNTARY MOVEMENT COMPONENTS IN THE DOGS

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Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-110 to S-113. refs

The role of the neostriatal efferent systems in the control of the components of postural adjustment and voluntary movement in dogs was investigated by obtaining parameters of the tensogram of the working limb, the electromyograms of the m. rectus femoris and m. semitendinosus of the working (left) and supporting (right) hind limb, and the mechanogram of the working limb. The effects of the following factors were evaluated: (1) preliminary electrical stimulation of the head of the nucleus caudatus (HNC) in the right or the left hemispheres, (2) systematic injections of L-dopa and haloperidole, and (3) injections of dopamine and carbacholine into the HNC. The results obtained suggest that the various components of the postural adjustment and the tonic and phasic components of the learned movement are controlled by different transmitter systems of neostriatum. I.S.

A92-39168

AN ENDOCRINE RESPONSE TO SHORT-TERM HYPODYNAMY IN JAPANESE QUAIL SELECTED FOR RESISTANCE TO HYPODYNAMY

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Reactions of the endocrine system to short-term (maximum 4 hrs) hypokinesia were compared in two lines of Japanese quail: a nonselected line and a line selected for its resistance to hypodynamy using, as a selection criterion, cumulative egg laying during 14 days of hypodynamy. Results indicated that, while the adrenal reaction to four hours of hypodynamy was pronounced in both lines of quail, significantly higher levels of noradrenaline and corticosterone were observed in hens of the selected line, and the production of estradiol was less depressed. On the other hand, concentrations of thyroid hormones decreased more rapidly in hens of the selected-line. I.S.

A92-39169

THE EFFECT OF THE DIFFERENT GRAVITY ON THE MUSCLE COMPOSITION IN JAPANESE QUAIL

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The effect of hypergravitation on the composition of different muscles in Japanese quail was investigated in hens exposed for 6 days to hypergravitation (2-1.5 G and 1.1 G) in a centrifuge. It was found that, while the chronic hypergravitation affected some parameters of the muscle metabolism of Japanese quail, it did not affect different individual muscles to the same extent. For instance, increased G lowered the contents of the sarcoplasmic and myofibrillar proteins in the breast muscles, but lowered the contents of both protein fractions in the thigh and the calf muscles. A strong effect of rotation was showed on the values of the muscle size, myofibrillar proteins, and plasma corticosterone, indicating that rotation per se is a powerful stressor which might have strongly contributed to the results of this study. I.S.

A92-39170

HYPERGRAVITY AND DEVELOPMENT OF MAMMALS

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USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-135, S-136. refs

The effects of microgravity and hypergravity on the development of organs in embryo and in young and adult mammals are compared using literature data. It was found that the general patterns of changes in the developmental response due to gravity changes by either plus or minus 1G of the ground gravity were very similar, despite the opposite direction of the gravity change. The results demonstrate the contribution of a nonspecific stressor component to the mammalian responses to gravitation changes, and indicate that centrifuge experiments can be used for studies of the effect of weightlessness. I.S.

A92-39171

FUNCTIONAL MORPHOLOGY OF PITUITARY IN RATS DEVELOPED UNDER INCREASED WEIGHTNESS AND RELATIVELY DECREASED WEIGHTNESS

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The effects of hypergravity (centrifugation at 2 G) and the change to relative hypogravity (1 G) on the development of the pituitary of rats were investigated in 60-day-old animals developed pre- and postnatally under 2G and then exposed to 1G, by analyzing the functional statuses of somato-, thyro-, and gonadotrophs of the anterior pituitary as well as the neurosecretory structures of the posterior pituitary. Histochemical examinations of rats grown under 2 G revealed a marked hypofunction of adenohypophyseal cells and a low baseline level of functioning of the neurosecretory structure. On day 2 after the transition to 1 G, there were signs of an activation of somato-, thyro-, and gonadotrophs and a release of an ADH-containing neurosecretion. I.S.

A92-39172

BLOOD AND BONE MARROW OF RATS BORN AND GROWN UNDER HYPERGRAVITY

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The effect of the transition to earth gravity of rats born and grown postnatally for 60 or 75 days under hypergravity (centrifugation at 2G) on the morphological compositions of blood and the bone marrow was investigated by examining these tissues 2 or 15 days after transfer to 1G. Results of examinations showed that the hemopoietic adaptation process in rats which developed pre- and postnatally under 2G was not completed; in 60-day-old rats, there were increases of erythroid production and eosinophilopoiesis and a decline in the level of neutrophilopoiesis. Transition to the earth gravity caused a still greater increase in erythroid production and a tendency for normalization of granulopoiesis. I.S.

A92-39173

THE MICROGRAVITY EFFECT ON A REPAIR PROCESS IN M. SOLEUS OF THE RATS FLOWN ON COSMOS-2044

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The effect of microgravity on the repair process in M. soleus of rats was investigated in animals subjected to operative injury and either flown aboard Cosmos-2044 for 14 days or subjected to tail suspension. Results of microscopic examinations showed that M. soleus in rats of both groups displayed signs of severe

atrophy, although the muscles of the microgravity-exposed rats and of the controls were at one and the same stage of repair. The repair process in tail-suspended rats was characterized by the same regularities as in the space-flown animals. I.S.

A92-39174* National Aeronautics and Space Administration, Washington, DC.

WEIGHTLESSNESS AND THE ONTOGENY OF VESTIBULAR FUNCTION - EVIDENCE FOR PERSISTENT VESTIBULAR THRESHOLD SHIFTS IN CHICKS INCUBATED IN SPACE

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(Contract NAGW-1275; NIH-R15-NS-2600)

The effect of microgravity on the embryonic development of the vestibular function was investigated by comparing the vestibular function parameters measured in 21-old chicks incubated as embryos aboard the Space Shuttle Discovery with those of age-matched synchronous controls incubated on earth. Measurements of the electrophysiological responses in both groups of chicks indicated that the exposure of embryos to weightlessness resulted in altered sensitivity of embryonic vestibular sensors. Moreover, the effect of space flight was persistent: it was still present one month after the spacecraft landed on earth. I.S.

A92-39175

STUDIES OF CIRCADIAN RHYTHMS IN SPACE FLIGHT - SOME RESULTS AND PROSPECTS

A. M. ALPATOV (Institute of Biomedical Problems, Moscow, Russia) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-145, S-146. refs

The effect of space flight on the circadian rhythm stability of insects and mammals was investigated using data collected on beetles, rats, and primates flown aboard the Cosmos-1514, -1667, and -1887 biosatellites. The analyses of data on the deviations of circadian periods of body-temperature and motor-activity rhythms indicate that, as a result of space flight, the stability of the circadian rhythm decreases and a shift of the endogenous circadian period occurs. It is pointed out that both these effects should result in a high chance of desynchronization in space flights. I.S.

A92-39176* National Aeronautics and Space Administration, Washington, DC.

EFFECTS OF GRAVITY ON THE CIRCADIAN PERIOD IN RATS

DEAN M. MURAKAMI, VICTOR H. DEMARIA, and CHARLES A. FULLER (California, University, Davis) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-147, S-148. refs
(Contract NAGW-2195)

The effect of increased gravity force on the circadian period of body temperature and activity of rats was investigated using rats implanted with a small radio telemetry device and, after a 2-week recovery and a 3-week control period at 1G, rotated at for 4 weeks at a constant 2G field in a 18-ft-diam centrifuge. Measurements of the mean freerunning period of the temperature and activity rhythms after 10 days showed that the exposure to 2G led to a functional separation of the pacemakers that regulate the activity and the temperature in the animals. Each pacemaker reacted differently: the activity period increased and the temperature period decreased. By the third or the fourth week,

the activity and the temperature periods have returned to 1G control levels. I.S.

A92-39177

INVESTIGATION OF HEART RATE AND BODY TEMPERATURE DYNAMICS DURING A 14 DAYS SPACEFLIGHT EXPERIMENT 'COSMOS 2044'

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The effect of microgravity on the body temperature dynamics and the heart rate (HR) was investigated in a monkey equipped with a biotelemetric temperature measuring system and flown aboard Cosmos-2044 for 14 days. Results of the biorhythm analyses indicated a decrease of the circadian rhythm stability (lower significance level) and the presence of phase shifting in both parameters. I.S.

A92-39184

EFFECTS OF +GZ ACCELERATIONS ON THE MECHANICAL BEHAVIOR OF RAT MYOCARDIUM OBSERVED IN ISOLATED PERFUSED HEART

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The effect of +Gz on the mechanical performance of the rat myocardium was evaluated in rats trained in a 1.8-m-radius centrifuge, by measuring with an intravenous balloon technique the pressure developed by the left ventricle. The cardiac work was modified by changing concentrations of extracellular calcium. A persistent decrease in the myocardial contractility was observed in the course of three 30-sec-long exposures to +10 Gz separated by plateaus at 1 Gz, indicating that changes in the inherent properties of the myocardial fiber might be occurring as a result of repeated exposures to high +Gz. I.S.

A92-39185

MODELLING OF CHANGES IN MECHANICAL CONSTRAINTS OF LEFT VENTRICULAR MYOCARDIUM (DIASTOLIC PHASE) UNDER +GZ ACCELERATION

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The behavior of the heart ventricular diastolic function under the conditions of high +Gz acceleration was investigated using a mathematical model to represent left ventricle. The model was a thick-walled vertical cylinder, the walls of which were made of an incompressible fluid in which elastic fibers were bathing. The fibers formed two networks of regular helices; their orientation was continuously changing inside the wall. The results of measurements of the radial and longitudinal deformations of the cylinder, caused by +Gz acceleration over 150 msec, show a significant effect of +Gz acceleration on the model during diastole (i.e., an increased sucking at the beginning of the filling phase, resulting in a pressure

drop, an increased filling volume and rate, an increased tension in fibers forming the outer wall of the ventricle, and the ventricle stretching associated with the wall thinning). I.S.

A92-39186

PROBLEM OF ECG ACQUISITION AND OCCURRENCE OF SIGNIFICANT CARDIAC ARRHYTHMIAS IN WHITE RATS IN GRAVITATIONAL STRESS

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The origin and the accuracy of the assessment of cardiac arrhythmias in gravitational stress are investigated by analyzing ECGs of unanesthetized rats equipped with subcutaneous electrodes, who were rotated in a 2.6-radius centrifuge with forces ranging from 0.02G to 2G. No ventricular fibrillation was observed in these experiments, though the experiments were terminated due to the electrical cardiac arrest, always preceded by the arrest of respiration. However, the results were not affected by the application of a beta-blocker metipronalol nor by the application of an alpha-1-blocker prazosin, indicating that hypoxia is not the main cause of significant arrhythmias observed in gravitational stress. I.S.

A92-39187* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

VARIATIONS IN RECOVERY AND READAPTATION TO LOAD BEARING CONDITIONS AFTER SPACE FLIGHT AND WHOLE BODY SUSPENSION IN THE RAT

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(Contract NAG2-386)

Result are presented on studies of the effects of space flight and simulated microgravity on the cardiovascular and electrolyte characteristics, the adrenal gland weight, and hormonal responses of rats flown aboard Cosmos-605 and -782 or exposed to whole-body tail suspension. Results indicate an age-independent decrease in circulating antinatriuretic factor (ANF) in suspended rats, indicating that ANF may not significantly contribute to the sustained elevated bariuresis and diuresis observed in chronic head-down-suspended rats. I.S.

A92-39188

FUNCTIONAL PROPERTIES OF SOLEUS AND EDL MUSCLES AFTER WEIGHTLESSNESS

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The effect of weightlessness on the contractile properties of single fibers from a slow muscle (soleus) and a fast muscle (extensor digitorum longus, EDL) of rats was evaluated by measuring the force amplitudes, tension/pCa relationships, and kinetics of force development in animals flown for 14 days aboard Cosmos-2044 and in control rats. Results showed pronounced morphological and functional changes in the soleus, but not in the EDL muscle fibers. I.S.

A92-39189

PHYSIOLOGICAL CHARACTERISTICS OF RAT SKELETAL MUSCLES AFTER THE FLIGHT ON BOARD 'COSMOS-2044' BIOSATELLITE

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RAPCSAK (Debrecen University of Medicine, Hungary) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) *Physiologist*, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-174 to S-176. refs

The mechanisms and the dynamics of the functional adaptation of mammalian skeletal muscles during the exposure to weightlessness were examined using preparations of glycerinated muscle fibers from forelimb, hindlimb, and postural muscles (with several muscles in each group) of rats of four groups: 2-week-long space flight (F) aboard Cosmos-2044, synchronous ground-based control experiment (S), vivarium control (V), and suspension (S-14). Results of muscle-fiber contractility and wet-weight studies showed that changes caused by 14-day spaceflight and by simulated weightlessness varied for different muscle groups as well as for different muscles in a given class. A comparison with literature reports on flights of shorter and longer duration suggested that animals in 14-day exposures are in an intermediate stage of the reconstruction of the skeletal muscles' functional profile. I.S.

A92-39190* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

MECHANISMS OF ACCELERATED PROTEOLYSIS IN RAT SOLEUS MUSCLE ATROPHY INDUCED BY UNWEIGHTING OR DENERVATION

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(Contract NAG2-384)

A hypothesis proposed by Tischler and coworkers (Henriksen et al., 1986; Tischler et al., 1990) concerning the mechanisms of atrophy induced by unweighting or denervation was tested using rat soleus muscle from animals subjected to hindlimb suspension and denervation of muscles. The procedure included (1) measuring protein degradation in isolated muscles and testing the effects of lysosome inhibitors, (2) analyzing the lysosome permeability and autophagocytosis, (3) testing the effects of altering calcium-dependent proteolysis, and (4) evaluating in vivo the effects of various agents to determine the physiological significance of the hypothesis. The results obtained suggest that there are major differences between the mechanisms of atrophies caused by unweighting and denervation, though slower protein synthesis is an important feature common for both. I.S.

A92-39191

PRELIMINARY RESULTS OF THE INFLUENCE OF DIRECT STIMULATION ON THE MECHANICAL PROPERTIES OF THE SOLEUS MUSCLE OF RATS DURING HINDLIMB SUSPENSION

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The effect of direct electrostimulation of hindlimb muscles of a rat, with the stimulation pattern resembling that of the natural firing of the innervating neurones, on the prevention of muscular atrophy during the exposure to simulated microgravity was investigated using rats subjected to hindlimb suspension (HS), HS rats with stimulation (HSS), and vivarium controls. It was found that the administration of electrostimulation prevented the decrease of the muscle wet weight due to hindlimb suspension and reversed the transformation of the soleus muscle to a faster muscle type. However, a loss of force was observed in muscles from both the HS and the HSS animals. I.S.

A92-39193**EFFECT OF STRAIN, DIET AND HOUSING ON RAT GROWTH PLATES - A COSMOS '87-SPACELAB 3 COMPARISON**

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Results are presented from a comparison study on the growth of longitudinal bones of rats flown aboard Cosmos-1129, -1887, -2044, and Spacelab 3. It was found that the values of the total epiphyseal growth-plates' height and the cell number per zone in bones of rats grown aboard these spacecraft were significantly affected by the conditions of housing, diet, and strain, with all the differences observed being in the hypertrophic/calcification zone. I.S.

A92-39194**ULTRASTRUCTURAL CHARACTERISTICS OF PLASTIC CHANGES IN THE BRAIN CORTEX OF RATS EXPOSED TO SPACE FLIGHT**

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The effect of spaceflights on different regions of the rat brain cortex was investigated by examining the ultrastructures of the somatosensory, visual, and olfactory cortex regions from rats flown for 7 days aboard Cosmos 1667 or for 14 days aboard Cosmos-1887 or -2044 biosatellites, as well as from rats of the ground-based synchronous control and vivarium groups. It was found that the changes in the ultrastructure which developed due to spaceflights were similar for all the brain-cortex regions under study. The differences were mainly due to the extent of the observed changes, the distribution density of the changed structures, and the specific features of their localization in the corresponding brain areas. I.S.

A92-39195**MORPHOLOGICAL CHANGES IN THE SPINAL CORD AND INTERVERTEBRAL GANGLIA OF RATS EXPOSED TO DIFFERENT GRAVITY LEVELS**

I. V. POLIAKOV, V. I. DROBYSHEV, and I. B. KRASNOV (Voronezh Medical Institute; Institute of Biomedical Problems, Moscow, Russia) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-187, S-188. refs

The effects of exposures to different levels of gravity on the morphological characteristics of the lumbar enlargement of the spinal cord (LESC) and of the lumbar intervertebral ganglia (LIVG) were investigated using rats flown for 14 days aboard Cosmos-1887 or -2044, rats subjected to 14-day-long tail suspension, rats centrifuged at 2G, and synchronous and vivarium controls (SC and VC, respectively). It was found that, compared to SC rats, the LIVG neurons of rats flown in space and exposed to the earth gravity for 6-8 hrs exhibited decreases in the body volume, cell nuclei, nucleoli, and the numbers of cells in the capsular glia, as well as a decline of the alkaline phosphatase activity in the glia cells. The LESC motoneurons from space-flown rats showed decreases in the volume of nucleoli and in the number of perineuronal glia cells. I.S.

A92-39198**RAT AND MONKEY BONE STUDY IN THE BIOCOSMOS 2044 SPACE EXPERIMENT**

ERIK ZERATH, XAVIER HOLY, ALEXANDRE MALOUIER, JEAN-CLAUDE CAISSARD, and CLAUDE NOGUES (Centre

d'Etudes et de Recherches de Medecine Aerospatiale, Bretigny-sur-Orge, France) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-194, S-195. Research supported by CNES. refs

The effect of microgravity on the morphological features of the cancellous bone tissues of rats and monkeys was investigated using Wistar rats and Rhesus monkeys flown for 14 days aboard Cosmos-2044. The results of the mineral labeling studies showed that the exposure to space flight resulted in decreased mineralization activity in the iliac cancellous bone of monkeys and in a transient increase in resorption in cells of rat humeri combined with a decreased osteoblast activity. I.S.

A92-39199**THE EFFECT OF MICROGRAVITY ON BONE FRACTURE HEALING IN RATS FLOWN ON COSMOS-2044**

A. S. KAPLANSKII, G. N. DURNOVA, T. E. BURKOVSKAIA, and E. V. VOROTNIKOVA (Institute of Biomedical Problems, Moscow, Russia) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-196 to S-199. refs

The effect of microgravity on the healing of bone fractures was investigated in rats subjected to bilateral fracturing of the fibula in the diaphyseal central portion and to crushing of limited portions of the m. soleus and m. gastrocnemius. These rats were subsequently subjected to one of the following treatments: (1) space flight for 14 days aboard Cosmos-2044 (2) ground-based synchronous experiment, (3) vivarium control conditions, and (4) tail suspension. Results of histomorphometric examinations showed that the exposure to spaceflight and tail suspension led to the inhibition of the healing process in the fractured long tubular bones, an increase of the relative osteoid volume in the callus trabeculae and a simultaneous decrease of the amount of active osteoplasts, and osteoporosis in the spongy bone of tibial metaphyses. I.S.

A92-39200**EFFECTS OF A TWO-WEEK SPACE FLIGHT ON OSTEOINDUCTIVE ACTIVITY OF BONE MATRIX IN WHITE RATS**

D. I. SUMAROKOV, D. V. GUTKIN, V. M. OGNIVENKO, V. M. KUDYMOV (Moscow Medical Stomatological Institute, Russia), V. S. OGANOV, and A. V. BAKULIN (Institute of Biomedical Problems, Moscow, Russia) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-200, S-201. refs

The hypothesis of Sumarokov (1987), according to which the biochemical and morphological alterations of the bone tissue in spaceflight are due changes in the contents of 'osteoinductive factors' and 'osteoinhibiting factors', was tested by estimating the contents of these factors in the bone tissue of rats flown for 14 days aboard Cosmos-2044 and of rats kept in tail suspension. The method used in these assays is based on the estimation of the potency of to induce ectopic osteogenesis by bone tissue samples taken from experimental and from control rats and transplanted into m. pectoralis major and m. quadriceps femoris of intact rats. It was found that, compared with the vivarium and synchronous controls, rats exposed to spaceflight and simulated-microgravity conditions exhibited increased rates of ectopic osteogenesis and reduced potency to inhibit osteogenesis. I.S.

A92-39201**PROTECTION OF CHINESE MEDICINE CWJ AGAINST SUSPENSION-INDUCED BONE-LOSS IN RATS**

ZHIZHEN SHI, SHILIANG SHEN, WEI CHUI, RUIXIAN LI, and DANDAN LI (Institute of Space Medico-Engineering, Beijing, People's Republic of China) (International Union of Physiological

Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-202, S-203. refs

The effect of the kidney-nourishing herb CWJ on bone metabolism was investigated by measuring the rate of bone formation in the femurs of rats subjected for 21 days to tail suspension and fed sugar solutions with or without CWG (0.2 mg/ml) added to it (CWJ and SC groups, respectively). It was found that the major contents of bone calcium, phosphorus, and protein were higher, and the fat contents were lower, in the CWJ rats than they were in SC rats. In addition, the contents of the atrial natriuretic peptide in the auricle and the blood plasma were significantly lower in the CWJ group than in the SC group. I.S.

A92-39202

FUNCTIONAL AND ADAPTIVE CHANGES IN THE VESTIBULAR APPARATUS IN SPACE FLIGHT

D. V. LYCHAKOV (Rossiiskaiia Akademiia Nauk, Institut Evoliutsionnoi Fiziologii i Biokhimii, St. Petersburg, Russia) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-204, S-205. refs

Results are presented from several studies on the effects of weightlessness and hypergravity on the morphological and biochemical characteristics in the vestibular apparatus. These experiments used frog larvae, fish larvae, and adult rats flown in space for 7 to 9 days; young fish subjected to 1.8-2 G centrifugation for 4 months; rats subjected to centrifugation at 2G for a month; and Rhesus monkeys kept in horizontal position under clinostatic or antiorthostatic hypokinetic conditions. Results show that the exposure to weightlessness does not produce pathological changes in the structural organization of vestibular receptors. However, changes in gravity were found to produce some functional and adaptive structural rearrangements in the otolith organs and in cristae. I.S.

A92-39203

THE OTOLITH APPARATUS AND CEREBELLAR NODULUS IN RATS DEVELOPED UNDER 2-G GRAVITY

I. B. KRASNOV (Institute of Biomedical Problems, Moscow, Russia) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-206, S-207. refs

The effect of hypergravity on the developments of the utricle and the cerebellar nodulus of rats was investigated in 60-day-old rats that developed pre- and postnatally under conditions of continuous centrifugation at 2G. Results of SEM and TEM studies indicated that the otoliths of the rats developed under 2G was characterized by adaptive changes due to higher gravity. This was expressed by the inhibition of the formation of large otoconia in the 'K' zone of the otoconial membrane. The adaptation process was found to continue in the postnatal life to day 60, as indicated by the fact that the ultrastructures of the utricle and the nodular cortex showed signs of the intense stimulation of gravireceptor cells and of higher impulsation coming from the otolith apparatus to the brain in the first 60 days of these rats. I.S.

A92-39204

FFT AND AMPLITUDE SPECTRUM EVALUATION OF STABILOGRAMS ON RATS WITH RESPECT TO A CONSISTENT SENSORIMOTOR SYSTEM OF ORIENTATION CONTROL (SOC)

LASZLO SIMON (Simmelweis University of Medicine, Budapest, Hungary) and ANDRAS ERDELY (National Institute of Occupational Health, Budapest, Hungary) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126

16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-208, S-209. refs

The effect of alcohol ingestion (1-4 g/kg body weight) on the posture control of rats in light and in dark was investigated by analyzing the FFT and amplitude spectra of the roll component of the stabilograms of experimental and control rats subjected to stabilography tests of Simon and Csiszar (1980). It was found that alcohol acted to enhance in similar way the noiselike signal of stabilograms spectra obtained in light and in dark. I.S.

A92-39205

ORIENTATION-REFLEX-BASED EVALUATION OF POSTROTATORY NYSTAGMOGRAMS

LASZLO SIMON and ISTVAN CSISZAR (Simmelweis University of Medicine, Budapest, Hungary) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-210, S-211. refs

The adaptive changes in the horizontal canal function of adult rats subjected to the free-fall test (Simon et al., 1983) and the stabilography (Simon et al., 1987) test (relating the dynamic and the static otolithic functions, respectively) were investigated by performing, in addition, the horizontal rotational nystagmography procedure on these animals. These procedures were carried out before the unilateral plugging of the labyrinth and for three weeks later. On the basis of the results, a model of sensorimotor adaptation is proposed. I.S.

A92-39206

MATHEMATICAL SIMULATION OF THE GRAVITY RECEPTOR

A. V. KONDRACHUK, S. P. SIRENKO (Ukrainian Academy of Sciences, Institute of Physics, Kiev, Ukraine), and A. A. SHPOV (Institute of Biomedical Problems, Moscow, Russia) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-212, S-213. refs

A mathematical model of the otolith apparatus (OA) is developed on the basis of experimental data related to the OA structure and the physical and chemical characteristics of the OA elements and their organization. In this model, which is designed for the description of the displacements and strains arising inside the OA under the effect of quasi-static and periodic loadings, the otolith is considered as a soft elastic platelet, elastically fixed along its contour and immersed into liquid (endolymph). Results of calculations with the OA model are presented, showing that, under the same directions and magnitudes of arising inertia, the deformation of different sections of the otolith membrane are different. I.S.

N92-24683# California Univ., Irvine. Dept. of Ecology and Evolutionary Biology.

GENETIC VARIATION IN RESISTANCE TO IONIZING RADIATION

F. J. AYALA 24 Jun. 1991 12 p

(Contract DE-FG03-88ER-60713)

(DE92-005588; DOE/ER-60713/T1) Avail: NTIS HC/MF A03

We proposed an investigation of genetically determined individual differences in sensitivity to ionizing radiation. The model organism is *Drosophila melanogaster*. The gene coding for Cu, Zn superoxide dismutase (SOD) is the target locus, but the effects of variation in other components of the genome that modulate SOD levels are also taken into account. SOD scavenges oxygen radicals generated during exposure to ionizing radiation. It has been shown to protect against ionizing radiation damage to DNA, viruses, bacteria, mammalian cells, whole mice, and *Drosophila*. Two alleles, S and F, are commonly found in natural populations of *D. melanogaster*; in addition we have isolated from a natural population 'null' (CA1) mutant that yields only 3.5 pct. of normal SOD activity. The S, F, and CA1 alleles provide an ideal model system to investigate SOD-dependent radioresistance, because

each allele yields different levels of SOD, so that S is greater than F is much greater than CA1. The roles of SOD level in radioresistance are being investigated in a series of experiments that measure the somatic and germ-line effects of increasing doses of ionizing radiation. In addition, we have pursued an unexpected genetic event—namely the nearly simultaneous transformation of several lines homozygous for the SOD 'null' allele into predominately S lines. Using specifically designed probes and DNA amplification by means of the Tag polymerase chain reaction (PCR) we have shown that (1) the null allele was still present in the transformed lines, but was being gradually replaced by the S allele as a consequence of natural selection; and (2) that the transformation was due to the spontaneous deletion of a 0.68 Kb truncated P-element, the insertion of which is characteristic of the CA1 null allele. DOE

N92-25000* # National Inst. of Health, Bethesda, MD. Office of Science Policy.

NATIONAL INSTITUTES OF HEALTH PRESENTATION AT IPE CONFERENCE PROGRAM

CAROLINE HOLLOWAY *In* NASA, Washington, The Federal Conference on Intelligent Processing Equipment p 165-175 Apr. 1992

Avail: NTIS HC/MF A10 CSDL 06A

The conference objective was to set up a working dialogue among representatives from industry and various Federal agencies. Discussed here are present National Institutes of Health (NIH) support in the area of intelligent processing equipment (IPE) and how researchers can work together on future research objectives. Information is given in viewgraph form with accompanying comments. Author

N92-25047# Maryland Univ., College Park. Dept. of Botany. ACTIVE AND PASSIVE CALCIUM TRANSPORT SYSTEMS IN PLANT CELLS

H. SZE 1991 6 p

(Contract DE-FG05-86ER-13461)

(DE92-005469; DOE/ER-13461/6) Avail: NTIS HC/MF A02

The ability to change cytoplasmic $\text{Ca}(2+)$ levels ($\text{Ca}(2+)$) by cells has made this cation a key regulator of many biological processes. Cytoplasmic $\text{Ca}(2+)$ is determined by the coordination of passive $\text{Ca}(2+)$ fluxes which increase cytosolic $\text{Ca}(2+)$ and active $\text{Ca}(2+)$ transport systems that lower cytosolic $\text{Ca}(2+)$. The mechanisms by which plant cells achieve this is poorly understood. We have initially used isolated vesicles from the plasma membrane or organellar membranes to study $\text{Ca}(2+)$ transport systems in oat roots (a monocot) and carrot suspension cells (a dicot). The objectives of the proposal were to identify and characterize active (energy-dependent) and passive calcium transport systems that work together to regulate calcium levels in the cytoplasm of plant cells. DOE

N92-25423# State Univ. of New York, Stony Brook. X RAY MICROIMAGING BY DIFFRACTIVE TECHNIQUES

1991 40 p

(Contract DE-FG02-89ER-60858)

(DE92-005530; DOE/ER-60858/2) Avail: NTIS HC/MF A03

Progress is reported on high resolution x-ray techniques that were developed to image wet biological specimens. The minimization of radiation damage to the specimens and holographic imaging are described. DOE

N92-26160# National Inst. of General Medical Sciences, Bethesda, MD. STRUCTURES OF LIFE: DISCOVERING THE MOLECULAR

SHAPES THAT DETERMINE HEALTH OR DISEASE, JULY 1991

M. PINES Jul. 1991 73 p

(PB92-147834; NIH/PUB-91/2778) Avail: NTIS HC/MF A04

The report discusses research in the molecular shapes of DNA that cause human disease or contribute to human health. Topics include the following areas: the search for key biological shapes; the reason why proteins fold; recognizing protein structures; deciphering the structure of membrane proteins; the way in which

proteins turn genes on or off; and seeking a cure for the common cold. Other discussions cover drug design and the use of new technology in speeding research on DNA structures. A glossary is included. Author

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AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

A92-37169

PERIPHERAL AND CENTRAL BLOOD FLOW IN MAN DURING COLD, THERMONEUTRAL, AND HOT WATER IMMERSION

FLEMMING BONDE-PETERSEN, LONE SCHULTZ-PEDERSEN, and NILS DRAGSTED (Danish Aerospace Medical Centre of Research, Copenhagen, Denmark) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 63, no. 5, May 1992, p. 346-350. refs

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A92-37171

SALIVARY SECRETION AND SEASICKNESS SUSCEPTIBILITY

CARLOS R. GORDON (Tel Aviv University; Israel Naval Hyperbaric Institute, Haifa), Yael JACKMAN, HANNA BEN-ARYEH (Technion - Israel Institute of Technology, Haifa), ILANA DOWECK, ORNA SPITZER (Israel Naval Hyperbaric Institute, Haifa), RAYMONDE SZARGEL (Technion - Israel Institute of Technology, Haifa), and AVI SHUPAK (Israel Naval Hyperbaric Institute, Haifa) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 63, no. 5, May 1992, p. 356-359. refs

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The salivary flow rate and composition of 2 groups of 31 subjects, one group at each extreme of the seasickness susceptibility scale, were compared. No significant differences were found between the two groups in flow rates and electrolyte concentrations of whole resting and stimulated saliva. Amylase activity and rate of secretion in resting saliva were significantly higher in subjects susceptible to seasickness as compared with nonsusceptible subjects. Also, the total protein rate of secretion in resting saliva was significantly higher in the susceptible group. The present findings could be explained in terms of higher sympathetic tone in subjects susceptible to seasickness, and salivary amylase levels might be recommended as an additional parameter in the evaluation of seasickness susceptibility. Author

A92-37174* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.

EFFECT OF BREAKFAST ON SELECTED SERUM AND CARDIOVASCULAR VARIABLES

MARY A. B. FREY, MARION P. MERZ, and G. W. HOFFLER (NASA, Kennedy Space Center; Bionetics Corp., Cocoa Beach, FL) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 63, no. 5, May 1992, p. 370-374. refs

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In view of the objections of many subjects to overnight fasting prior to their blood being drawn for analyses, the effect of eating breakfast on the results of subsequent blood analyses of selected blood constituents and on cardiovascular variables was investigated in 47 men and 34 women who were subjected to blood analyses on two occasions, one week apart: once fasting and once after breakfast. Results suggest that subjects need not fast overnight before blood is being drawn for determinations of the HDL-C levels, hemoglobin, hematocrit, total cholesterol, or phosphorus. However, based on other studies, it is suggested breakfast should not have a high content of fat. I.S.

A92-37175

HIV POSITIVITY AND AVIATION SAFETY

Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 63, no. 5, May 1992, p. 375-377. refs
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The paper presents the report, prepared by the Aviation Safety Committee with participation of an ad hoc committee formed by the Executive Committee of the Aerospace Medical Association, on the relationship between infection with human immunodeficiency virus (HIV) and aviation safety. Attention is given to the natural history of HIV infection, the neuropsychiatric effects of the infection, and the inappropriateness of clinical neuropsychiatric testing to determine fitness to fly. It is suggested that a HIV-infected pilot places the flying public at increased and unnecessary risk, and is proposed that pilots should be tested for infection by the HIV virus, and, if found to be infected, should be medically disqualified for flying duties. I.S.

A92-37786

OXYGEN COST OF EXERCISE HYPERPNEA - MEASUREMENT
E. A. AARON, B. D. JOHNSON, C. K. SEOW, and J. A. DEMPSEY (Wisconsin, University, Madison) Journal of Applied Physiology (ISSN 8750-7587), vol. 72, no. 5, May 1992, p. 1810-1817. Research supported by NIH and U.S. Army. refs
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Eight healthy adult subjects were required to mimic, at rest, the important mechanical components of submaximal and maximal exercise hyperpnea in order to quantitate the O₂ cost of maximal exercise hyperpnea. Expired minute ventilation (V-dot-E), transpulmonary and transdiaphragmatic pressures, and end-expiratory lung volume (EELV) were measured during exercise at 70 and 100 percent of maximal O₂ uptake. At rest, subjects were given visual feedback of their exercise transpulmonary pressure-tidal volume loop (W-dot-v), breathing frequency, and EELV, which they mimicked repeatedly for 5 min per trial over several trials, while hypocapnia was prevented. The O₂ costs of hyperpnea correlated highly and positively with V-dot-E and W-dot-v. The O₂ cost of V-dot-E rose out of proportion to the increasing hyperpnea. It is argued that these data provide a realistic conservative estimate of the actual cost of exercise hyperpnea over a broad range of ventilatory outputs during moderately heavy-to-maximum exercise in healthy human subjects. C.A.B.

A92-37787

OXYGEN COST OF EXERCISE HYPERPNEA - IMPLICATIONS FOR PERFORMANCE

E. A. AARON, K. C. SEOW, B. D. JOHNSON, and J. A. DEMPSEY (Wisconsin, University, Madison) Journal of Applied Physiology (ISSN 8750-7587), vol. 72, no. 5, May 1992, p. 1818-1825. Research supported by NIH and U.S. Army. refs
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The questions of whether exercise hyperpnea ever attains a 'critical useful level' and whether the work of breathing at maximum O₂ uptake is fatiguing to the respiratory muscles are addressed. It is concluded that the O₂ cost of exercise hyperpnea is a significant fraction of the total maximum O₂ uptake but is not sufficient to cause a critical level of 'useful' hyperpnea to be achieved in healthy subjects. The O₂ cost of ventilation and the work of breathing during maximum exercise are nonfatiguing and sustainable. C.A.B.

A92-37788* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

EFFECT OF LEG EXERCISE TRAINING ON VASCULAR VOLUMES DURING 30 DAYS OF 6 DEG HEAD-DOWN BED REST

J. E. GREENLEAF, J. VERNIKOS, C. E. WADE, and P. R. BARNES (NASA, Ames Research Center, Moffett Field; U.S. Army, Letterman Army Institute of Research, San Francisco; San Francisco State University, CA) Journal of Applied Physiology (ISSN 8750-7587), vol. 72, no. 5, May 1992, p. 1887-1894. Research supported by U.S. Army. refs
(Contract NAG2-410)
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In order to investigate the effects of leg exercise training on

vascular volumes during 30 d of 6-deg head-down bed rest, plasma and red cell volumes, body density, and water balance were measured in 19 men confined to bed rest (BR). One group had no exercise training (NOE), another near-maximal variable-intensity isotonic exercise (ITE) for 60 min/d, and the third near-maximal intermittent isokinetic exercise (IKE) for 60 min/d. Mean energy costs for the NOE, IKE, and ITE regimens were determined. Body densities within groups and mean urine volumes between groups were unchanged during BR. Changes in red cell volume followed changes in plasma volume. There was close coupling between resting plasma volume and plasma protein and osmotic content. It is argued that the ITE training protocol is better than the IKE protocol for maintaining plasma volume during prolonged exposure to BR. C.A.B.

A92-38115* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

ENERGY REQUIREMENTS FOR SPACE FLIGHT

HELEN W. LANE (NASA, Johnson Space Center, Houston, TX) Journal of Nutrition (ISSN 0022-3166), vol. 122, 1992, p. 13-18. refs
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Both the United States and the Soviet Union perform human space research. This paper reviews data available on energy metabolism in the microgravity of space flight. The level of energy utilization in space seems to be similar to that on earth, as does energy availability. However, despite adequate intake of energy and protein and in-flight exercise, lean body mass was catabolized, as indicated by negative nitrogen balance. Metabolic studies during simulated microgravity (bed rest) and true microgravity in flight have shown changes in blood glucose, fatty acids and insulin concentrations, suggesting that energy metabolism may be altered during space flight. Future research should focus on the interactions of lean body mass, diet and exercise in space, and their roles in energy metabolism during space flight. Author

A92-38130* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

NUTRITIONAL QUESTIONS RELEVANT TO SPACE FLIGHT

HELEN W. LANE (NASA, Johnson Space Center, Houston, TX) and LESLIE O. SCHULZ (Wisconsin, University, Milwaukee) Annual Review of Nutrition (ISSN 0199-9885), vol. 12, 1992, p. 237-258. refs
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This historical review of nutritionally related research in the U.S. and Soviet space programs discusses the uses of nutrition as a countermeasure to the effects of microgravity, with respect to body composition and to exercise. Available information is reviewed from space and ground research in the nutritional requirements for energy, protein, fluids, electrolytes, vitamins, and minerals. Past, present, and future systems for nutrient delivery in space are described, and finally, future directions and challenges are presented. Author

A92-38147* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

HEMATOLOGY AND BIOCHEMICAL FINDINGS OF SPACELAB 1 FLIGHT

CAROLYN S. LEACH (NASA, Johnson Space Center, Houston, TX), J. P. CHEN (Tennessee, University, Knoxville), W. CROSBY (U.S. Army, Walter Reed Army Medical Center, Washington, DC), P. C. JOHNSON (NASA, Johnson Space Center, Houston, TX), R. D. LANGE (Tennessee, University, Knoxville), E. LARKIN (USVA Hospital, Martinez, CA), and M. TAVASSOLI (NASA, Johnson Space Center, Houston, TX; Mississippi, University, Jackson) IN: Regulation of erythropoiesis. New York, PMA Publishing Corp., 1988, p. 415-453. refs
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The changes in erythropoiesis in astronauts caused by weightlessness was experimentally studied during the Spacelab 1 flight. Immediately after landing showed a mean decrease of 9.3 percent in the four astronauts. Neither hyperoxia nor an increase in blood phosphate caused the decrease. Red cell survival time

and iron incorporation postflight were not significantly different from their preflight levels. Serum haptoglobin did not decrease, indicating that intravascular hemolysis was not a major cause of red cell mass change. An increase in serum ferritin after the second day of flight may have been caused by red cell breakdown early in flight. The space flight-induced decrease in red cell mass may result from a failure of erythropoiesis to replace cells destroyed by the spleen soon after weightlessness is attained. C.D.

A92-38158* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

SPACE SHUTTLE DOSIMETRY MEASUREMENTS WITH RME-III

K. A. HARDY (USAF, Armstrong Laboratory, Brooks AFB, TX), M. J. GOLIGHTLY, A. C. HARDY (NASA, Johnson Space Center, Houston, TX), W. ATWELL (Rockwell International Corp., Space Transportation Systems Div., Houston, TX), and W. QUAM (EG&G Energy Measurements, Inc., Goleta, CA) Conference on Radiation Protection and Dosimetry, 3rd, Orlando, FL, Oct. 21-24, 1991, Paper. 11 p.

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A description of the radiation monitoring equipment (RME-III) dosimetry instrument and the results obtained from six Space Shuttle flights are presented. The RME-III is a self-contained, active (real-time), portable dosimeter system developed for the USAF and adapted for utilization in measuring the ionizing radiation environment on the Space Shuttle. This instrument was developed to incorporate the capabilities of two earlier radiation instruments into a single unit and to minimize crew interaction times with longer battery life and expanded memory capacity. Flight data has demonstrated that the RME-III can be used to accurately assess dose from various sources of exposure, such as that encountered in the complex radiation environment of space. R.E.P.

A92-38520* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

SPACE RESEARCH ON ORGANS AND TISSUES

MARC E. TISCHLER (Arizona, University, Tucson) and EMILY MOREY-HOLTON (NASA, Ames Research Center, Moffett Field, CA) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 9 p. refs

(AIAA PAPER 92-1345) Copyright

The effects of microgravity on various physiological systems are reviewed focusing on muscle, bone, cardiovascular, pulmonary, neurovestibular, liver, and endocrine systems. It is noted that certain alterations of organs and tissues caused by microgravity are not reproducible in earth-bound animal or human models. Thus space research on organs and tissues is essential for both validating the earth-bound models used in laboratories and studying the adaptations to weightlessness which cannot be mimicked on earth. O.G.

A92-38536* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

SLEEP AND CIRCADIAN RHYTHMS IN LONG DURATION SPACE FLIGHT - ANTARCTICA AS AN ANALOGUE ENVIRONMENT

PHILIPPA H. GANDER (NASA, Ames Research Center, Moffett Field, CA) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 9 p. refs

(AIAA PAPER 92-1370) Copyright

The feasibility of using Antarctica as an environment for studying the impact of unusual 24 h environmental cycles (zeitgebers) on the circadian system is discussed. Adaptation of circadian rhythms and sleep of three scientists travelling from New Zealand to Antarctica during summer (which is analogous to arrival at a lunar base during the lunar day) has been studied. Data obtained indicate that sleep occurred at the same clock time, but sleep quality was poorer in Antarctica, which can be explained by the fact that the circadian system delayed by about 2 h in Antarctica, as would be expected in a weaker zeitgeber environment. It is suggested that sleep could be improved by altering patterns of exposure to the available zeitgebers to increase their effective strength. O.G.

A92-39128

CURRENT STATUS OF ACUTE HIGH-G PHYSIOLOGY

RUSSELL R. BURTON (USAF, School of Aerospace Medicine, Brooks AFB, TX) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-11 to S-14. refs

The current status of the research on the effect of high sustained G (HSG, 7G or greater sustained for 15 sec or longer) on the physiological parameters of the pilot is discussed with special attention given to the individual effects of both the imposed gravity and the duration of this environment. Particular consideration is given to the G-induced loss of consciousness and the effect of HSG on pilots with a cardiovascular condition. It is pointed out that the lack of knowledge on the degree of the coronary artery disease in pilots that begins to compromise heart function during an exposure to HSG has caused many pilots of high-performance aircraft, who perhaps should be flying, to be disqualified. The future direction of high-G acceleration research in support of pilots of high performance aircraft is outlined. I.S.

A92-39130

GRAVITATIONAL FIELDS AND AGING

JULIAN R. YOUNG and ARTHUR H. SMITH (California, University, Davis) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-19 to S-22. refs

The effect of aging on various physiological functions of humans are examined using relevant literature data and are compared to the effect of microgravity on young human subjects flown in space. It is shown that very few changes due to aging correlate in direction with the microgravity-induced effects and that it is not possible to predict what will be the influence of aging on the tolerance to weightlessness or how weightlessness would affect the aging process. It is suggested that laboratory experiments on the effect of weightlessness should include studies on subjects of different ages. I.S.

A92-39132

HUMAN EXPERIMENTS ON SPACELAB SLS-1

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The experiments to be performed on board the Spacelab SLS-1, designed to investigate human responses to space flight, are described in detail. These experiments include studies on adaptive responses of the cardiovascular-cardiopulmonary system, renal-endocrine system, blood-immune system, musculoskeletal system, and neurovestibular system. In every case, the flight experiments will be preceded by a series of 1-G preflight controls, and there will be extensive postflight measurements. I.S.

A92-39134

GRAVITATIONAL ASPECTS OF THERMOREGULATION AND AEROBIC WORK CAPACITY

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Results are presented on suit immersion (SI) experiments, in which physical efficiency and endurance data for human subjects were collected before and after SI, and SI and orbital flight experiments in which data on body thermoregulation were obtained. Results suggest that body temperature is a gravity-dependent factor. It is suggested that one of the ways of maintaining the heat status and the capability for energy formation of subjects in

space may be the administration of such physiologically active compounds as indirect sympathomimetics, neuroactive amino acids, metabolites, adaptogens, and preparations that normalize mineral metabolism. I.S.

A92-39135

PATHOGENESIS OF SENSORY DISORDERS IN MICROGRAVITY

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Results are presented from investigations of the pattern and the etiology of sensory disorders observed in crewmembers participating in the spaceborne experiments Optokinesis (Kornilova et al., 1987) and Labyrinth (Grigorova et al., 1989). These experiments addressed spontaneous oculomotor reactions and reactions elicited by vestibular, visual, and combined vestibulovisual stimulation. It was found that all subjects could be divided into three types: type I, subjects whose responses to all stimuli were distinct; type II, subjects with weak or absent responses to all stimuli; and type III, subjects whose responses to stimuli varied and included changes in the role of sensory inputs. I.S.

A92-39137

MEDICAL RESULTS OF THE MIR YEAR-LONG MISSION

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Results are presented from a year-long (December 21, 1987 through December 21, 1988) manned mission performed aboard the Soviet orbital complex Mir-Soyuz-TM-Quant-Progress. The crew consisted of two members who performed experiments designed to monitor changes in general body and health characteristics, cardiovascular parameters, the motor system, bone loss, metabolic parameters, and visceral organs; a graded exercise test on a bicycle ergometer and LBNP measurements were also performed. In addition, changes induced by EVA were obtained, including those in the carbohydrate and lipid metabolism, serum-enzyme activities, and fluid-electrolyte metabolism. Other experiments involved monitoring of changes in the hormonal status, blood parameters, and immune reactivity. It was found that changes observed in vital physiological systems after one year in space were not different from those reported for shorter flights. Moreover, some changes were even less significant. I.S.

A92-39144

ADRENERGIC REGULATION AND MEMBRANE STATUS IN HUMANS DURING HEAD-DOWN HYPOKINESIA (HDT)

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The status of erythrocyte cellular membrane and the responsiveness of erythrocytes to adrenergic hormones were investigated in two groups (A and B) of human subjects exposed to 370-day-long head-down-tilt (HDT, at 6 deg) hypokinesia followed by a recovery period. In group A, HDT bed rest was combined with daily exercise and pharmacological drugs as countermeasures, while group-B subjects were using countermeasures only from day 120. The parameters measured were changes in binding of fluorescent DSM, amounts of catecholamines in urine and blood,

fatty acid composition of membrane phospholipids, transport ATPase activity, intracellular contents of K(+) and Na(+), and the rate of K(+) leakage. Results indicated that, although the countermeasures had a certain corrective effect, they failed to prevent the alterations in erythrocyte membranes caused by HDT (which included changes in the activity of membrane-bound ATPase, the membrane permeability and charge, and the density and rigidity of its lipid bilayer). I.S.

A92-39150

HUMAN CENTRIFUGE TRAINING OF MEN WITH LOWERED +GZ ACCELERATION TOLERANCE

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A training method for increasing the acceleration tolerance limit (ATL) in pilots was developed, in which the +Gz loads in human centrifuge are applied gradually, based on measurement of the blood velocity and heart-rate changes. In the procedure, the +Gz stimuli are applied with such characteristics which are best tolerated by human body systems. A slow acceleration onset was used, and subjects were exposed to constant values of acceleration which did not exceed their physical compensation limits. The load value was changed after each centrifuge run since the examination was stopped before the occurrence of retrograde blood flow. This training method is shown to increase the ATLs of pilots with Gz+ tolerance lowered by various causes. I.S.

A92-39151

TOLERANCE TO +GZ GRAVITATIONAL STRESS BY SUBJECTS OF ELDER AGE GROUPS WITH DIFFERENT HEALTH STATE

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The effects of age and health on tolerance to +Gz loads were investigated in fliers and nonfliers subjected to human centrifuge tests. Results of heart rate and blood velocity measurement obtained on 671 subjects aged 21 to 59 showed a well-defined age dynamics of the g-load tolerance in both fliers and nonfliers. Subjects aged between 25 and 40 were found to exhibit the highest level of g-load tolerance. It was also found that, in fliers and nonfliers aged 36 years or more, the presence of ectopic dysrhythmia led to significantly lower tolerance. I.S.

A92-39153

IS ANF IMPLIED IN THE IMPROVEMENT OF ORTHOSTATIC TOLERANCE DURING HEAD-DOWN BED REST?

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The effects of weightlessness on the volume-regulating hormones and the hormonal rhythms were investigated together with the mechanism involved in the improvement in the orthostatic tolerance by LBNP. It was found that the exposure of human subjects to 4-week-long head-down (-6 deg) bed rest without LBNP led to a decrease in weight and plasma volume, a 50 percent decrease in the atrial natriuretic factor (ANF), a decrease in

norepinephrine, a stimulation of the RAAS rhythm, and an orthostatic hypotension with three syncopes at the end of bed rest. During 4-wk-long bed rest with LBNP, applied as a countermeasure, there was a lesser decrease in weight and plasma volume, a trend to increase in ANF, no change in other hormonal variables, and no decrease in orthostatic hypotension. It is suggested that the improvement in the orthostatic tolerance in presence of LBNP might be ANF dependent. I.S.

A92-39158**EVALUATION OF ENERGY METABOLISM IN COSMONAUTS**

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The effect of microgravity on the metabolism of humans was investigated in 27 cosmonauts after flights of 8 to 366 days aboard Salyut and in 39 subjects exposed to dry water immersion, bed rest, or head-down tilt for 6 to 370 days. Results of analyses of biochemical parameters of blood serum and plasma of subjects flown for 8 to 10 days showed significant increases of insulin, creatine phosphokinase (CPK), CPK-MM, and malate dehydrogenase-3 (MDH3), as well as decreases in glucose, lactate, MDH1, MDH2, and T3. Cosmonauts flown for 7-8 months exhibited significant decreases in triglycerides, and variations in MDH and isocitrate. Experiments with simulated microgravity showed that many changes consistently seen postflight develop at an early stage of exposure. I.S.

A92-39161* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.

MUSCLE STRENGTH AND ENDURANCE FOLLOWING LOWER LIMB SUSPENSION IN MAN

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The effect of lower-limb suspension on the muscle strength and muscle endurance was investigated in six men subjected to four weeks of unilateral unloading of a lower limb (using of a harness attached to a modified shoe), followed by seven weeks of weight-bearing recovery. Results showed a decrease in the cross-sectional area (CSA) of the thigh muscle and in the average peak torque (APT) during three bouts of 30 concentric knee extensions. While the thigh muscle CSA returned to normal after seven weeks of recovery, the APT recovery was still reduced by 11 percent, suggesting that muscle metabolic function was severely affected by unloading and was not restored by ambulation. I.S.

A92-39162**INFLUENCES OF ANTIORTHOSTATIC BED REST (ABR) ON FUNCTIONAL PROPERTIES OF NEUROMUSCULAR SYSTEM IN MAN**

IU. A. KORIAK and I. B. KOZLOVSKAIA (Institute of Biomedical Problems, Moscow, Russia) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) *Physiologist, Supplement* (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-107 to S-109.

The effect of decreased motor activity on functional and structural properties of muscles in man was investigated by measuring the contractile properties of m. triceps surae before the start and three days after the accomplishment of 4-month-long antiorthostatic (at -6 deg) bed rest, using a method of direct measurement of muscle tendon tension developing during voluntary

or evoked isometric muscle contraction. Results indicated that hypokinesia led to increased muscle fatigability and to a diminished ability of this muscle to mobilize contractile reserves. I.S.

A92-39164**DYNAMIC AND STATIC EXERCISES IN THE COUNTERMEASURE PROGRAMMES FOR MUSCULO-SKELETAL AND CARDIOVASCULAR DECONDITIONING IN SPACE**

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The mechanisms of musculoskeletal and cardiovascular deconditioning under microgravity are discussed together with the role of exercise as a countermeasure to these effects. Experimental results are presented showing that mild dynamic exercise leads to the moderate production and release of metabolites from aerobically working muscles and activates low-threshold muscle receptors (K receptors) which in turn induce moderating influence on the sympathetic tone, heart rate, vascular resistance, and systemic blood pressure and cause a marked increase of breathing frequency. Isometric contractions lead to the activation of threshold chemosensitive receptors (P receptors), which induce sympathetic excitation resulting in increases of the heart rate, vascular resistance, arterial pressure, and breathing depth. The type of exercise regimens that could be used as countermeasures for space deconditioning is considered. I.S.

A92-39165* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.

INTERACTION OF THE CAROTID BAROREFLEX, THE MUSCLE CHEMOREFLEX AND THE CARDIOPULMONARY BAROREFLEX IN MAN DURING EXERCISE

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The interaction of the muscle chemoreflex and the cardiopulmonary baroreflex with the carotid baroreflex in humans performing exercise was investigated in healthy subjects using specially designed exercise regimen and apparatus. Stimulation of the muscle chemoreflex was achieved by restricting blood flow in the exercising muscles by means of applying a pressure of 50 mm Hg, whereas cardiopulmonary baroreceptors were unloaded by employing LBNP of -20 mm Hg. The carotid baroreceptors were unloaded and stimulated by neck-pressure maneuvers (Sprenkle et al., 1986). Results showed that the cardiodecelerating capacity of the carotid baroreflex remains active during exercise, and may even be sensitized by the chemoreflex-induced increase in arterial pressure; but it is not affected by the cardiopulmonary baroreceptor activity. I.S.

A92-39166**AGE-DEPENDENCY OF SYMPATHETIC NERVE RESPONSE TO GRAVITY IN HUMANS**

TADAAKI MANO, SATOSHI IWASE, TAKEMASA WATANABE, and MITSURU SAITO (Nagoya University, Japan) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) *Physiologist, Supplement* (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-121 to S-124. refs

The response of the muscle sympathetic outflow to gravitational stress and the effect of age on this response were investigated

during head-up graded tilting of human subjects equipped with a tungsten microelectrode inserted percutaneously into the muscle nerve fascicle of the tibial nerve, to record the response of sympathetic nerve activity. Results of microneurography show that muscle sympathetic outflow in humans is governed by afferent inputs from baroreceptors and play an extremely important role in control of systemic blood pressure. With increase of age, the basal level of muscle sympathetic outflow becomes higher, while the muscle sympathetic nerve responsiveness to +Gz stress becomes reduced. I.S.

A92-39167* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.

NEUROMUSCULAR ASPECTS IN DEVELOPMENT OF EXERCISE COUNTERMEASURES

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The paper reviews data obtained at the Human Life Sciences Research Program at the Kennedy Space Center on the structural and functional characteristics of the human muscle and on the effects of simulated microgravity (head-down bed rest) and exercise on the muscle. It is shown that prolonged exposure to microgravity induced ultrastructural abnormalities and the atrophy of muscle and impaired muscle functioning (especially upon return to terrestrial gravity) and that ground-based models can be effectively used to study these changes. Results indicate that the incorporation of resistive exercise with a strong emphasis on the use of eccentric muscle action, in addition to concentric action, may provide a very effective countermeasure against muscle atrophy and dysfunction caused by long-duration exposures to microgravity. I.S.

A92-39178

CARDIOVASCULAR DISTURBANCES INDUCED BY A 25 DAYS SPACEFLIGHT AND A ONE MONTH HEAD DOWN TILT

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The effect of microgravity on the cardiovascular function of humans was investigated by analyzing main cardiac parameters of astronauts during a 25-day-long spaceflight and of subjects undergoing a 1-month long head-down tilt (HDT), with and without LBNP application. The results of measurements of the parameters of cardiac function and peripheral circulation showed that, in the absence of countermeasures (LBNP), vascular deconditioning symptoms developed promptly in both groups of subjects; the cardiac volumes and cardiac output were significantly decreased. It is also shown that long-term HDT is a suitable model for investigating the cardiovascular disturbances induced by microgravity and for assessing the effectiveness of countermeasuring devices. I.S.

A92-39179

ABOUT THE GREAT IMPORTANCE OF VENOUS BLOOD CIRCULATION IN THE PATHOGENESIS OF SPACEMAN STATE DISTURBANCES IN WEIGHTLESSNESS

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The effect of long-term space flights on the central venous pressure (CVP) of humans was investigated by measuring CVP of cosmonauts before, during, and after spaceflights of up to 11-month duration aboard the orbital station Mir, using a specially developed method. Results indicated that the CVP values of cosmonauts in space were higher by about 50 percent than those observed on earth. After 20 min of recovery on earth, the CVP values decreased to values about 45 percent below the original level. It was found that physical training and the application of clumping cuffs were effective as countermeasures. I.S.

A92-39180

CARDIAC HEMODYNAMICS AND ORTHOSTATIC STRESS - INFLUENCE OF DIFFERENT TYPES OF PHYSICAL TRAINING

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The effects of different types of physical training on the cardiac hemodynamic responses to orthostatic stress were investigated by measuring cardiac parameters in human subjects divided into three groups: endurance runners, weight-lifters, and nonathletes. It was found that, although the response patterns to orthostatic stress (exposures to -20 and -40 mbar in a LBNP chamber) in these subjects differed as a function of the type of sport, training had no significant bearing on the hemodynamic responses to the orthostatic stress induced by LBNP (at least down to -40 mbar); there was no evidence of an altered baroreflex function in the endurance trained men. I.S.

A92-39181

CENTRAL HEMODYNAMICS OF THE ANTI-G STRAINING MANEUVER PERFORMED DURING ELECTIVE CARDIAC CATHETERIZATION IN MAN

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Results are presented of a study undertaken to evaluate the central hemodynamic effects of the increased levels of the thoracic-abdominal Valsalva-like strain (V) performed with and without a peripheral musculoskeletal strain (the L-1 maneuver). The subjects were six Army aviators who underwent elective cardiac catheterization as part of an aeromedical evaluation. The data indicate that the initial response to the V or L-1 is a rise in central pressures. The reduction in the stroke volume was manifested by a diminished pulse pressure, seen in both V and L-1. There was a trend for the L-1 systolic pressure level to remain higher than in subjects not undergoing the L-1 maneuver; however, the differences in pressure level were minimal. I.S.

A92-39182

CARDIOVASCULAR RESPONSES TO OXYGEN UPTAKE DURING EXERCISE IN AXILLARIS WATER IMMERSION

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Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-160, S-161.

The nature of the cardiovascular adjustment to dynamic exercise under conditions of microgravity was investigated by comparing cardiovascular responses to the oxygen uptake and work intensity in control subjects to responses of subjects undergoing ergometer exercises under the condition of water immersion (WI) to the axillary level. Results showed that, when dynamic upright pedaling was performed under WI conditions, the increase in systolic arterial pressure with increasing $\dot{V}O_2$ and percent $\dot{V}O_{2(max)}$ was higher than in control subjects exercising under normal conditions. I.S.

A92-39183

COMPARISON OF CARDIOVASCULAR RESPONSES DURING POST-EXERCISE BETWEEN PEDALLING EXERCISE EXPOSED TO -50 MM HG LBNP AND KNEE BEND EXERCISE

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The capacities of two tests (a mild pedaling exercise during -50 mm Hg LBNP, followed by LBNP until it could no longer be tolerated, and a 1-min-long knee bending exercise) to evaluate cardiovascular responses of humans were evaluated in young female subjects. Measurements of the tolerance capacity and the systemic, mean arterial, and diastolic pressures showed significant correlation (p less than 0.01) between the arterial blood pressure ratio after 1 min knee bending exercise and the postexercise LBNP tolerance time. I.S.

A92-39192

CLASSIFICATION OF THE FREE FLUID RESERVOIR IN THE CALF BY ELECTRICAL IMPEDANCE TOMOGRAPHY

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The feasibility of using electrical impedance tomography for monitoring the fluid shifts in the calf that take place following changes in the body posture, saline infusion (FL), or LBNP stress test was examined using the Sheffield Applied Potential Tomography (APT) system. The overall APT images showed an exponential resistivity increase due to the body position change from the upright to 6-deg head-down-tilt (HDT) position. The pattern of the APT images obtained during LBNP looked the same as that during FL, with both patterns showing a resistivity decrease in the overall images. A comparison of the overall APT images with the tomograms obtained simultaneously by NMR showed the same tendencies, indicating that APT is an effective method for measuring changes in the fluid reservoir of the calf. I.S.

A92-39197

THE EFFECT OF REPEATED LOADS AND METABOLIC INTENSITY ON REPARATIVE-DESTRUCTIVE PROCESSES IN SPINE

IU. V. MAZURIN and G. P. STUPAKOV (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-191 to S-193. refs

The effect of repeated loads on the spine, with a probability of $p = 0.05$ of causing destruction and with a probability of causing microfissures as well as the stimulation of adaptive processes, were examined using the theoretical model of Stupakov et al.

(1989). The model describes the dynamics of the average number of impacted and crushed trabecula as a result of processes analogous to the chemical kinetics processes and the homeostasis restoration. Results of calculations show that this approach makes it possible to study the effects of the duration of loading, the likelihood of instant microlesions, the metabolic rate and the rate of aging of the organism under study, and the severity of osteochondropathy. I.S.

A92-39207

POSSIBILITY TO CHANGE OTOLITHIC-OCULAR STATIC ASYMMETRY BY GALVANIC STIMULATION OF VESTIBULAR APPARATUS

FRANTISEK HLAVACKA and MARIA KRIZKOVA (Slovak Academy of Sciences, Institute of Normal and Pathological Physiology, Bratislava, Czechoslovakia) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-214, S-215. refs

The possibility of influencing the otolithic - ocular static asymmetry by the galvanic stimulation of the vestibular apparatus was investigated in human subjects in whom the magnitudes of static ocular counterrolling, with and without galvanic stimulation, were measured by a simple indirect method. Results showed that the magnitude of ocular counterrolling was influenced by galvanic binaural stimulation of the vestibular system. The effect depended on the polarity and the intensity of stimulation. I.S.

A92-39208

THE VESTIBULAR EXPERIMENT IN THE JUNO MISSION

RUDOLF VON BAUMGARTEN (Mainz, Universitaet, Federal Republic of Germany) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-216, S-217. refs

The paper describes three vestibular experiments planned for the USSR Mir station missions scheduled for 1991 and/or 1992, in which subjects will be the astronauts. The first experiment is designed to determine the amount of ocular counterrotation caused by the neck position receptors during the static head tilt to the left or the right side. The second experiment is designed to support the hypothesis stating that, during the vestibular adaptation to space, the weighting of vestibular information increases in comparison to vestibular information. The third experiment consists of pre- and postflight on-ground measurements in which a new otolithometric test for predicting the susceptibility of subjects to space sickness will be used; the test is based on the assumption that subjects with a bilaterally asymmetric otolith apparatus are more susceptible to space sickness than those with symmetric apparatuses. I.S.

A92-39209

EXAMINATION OF EYE MOVEMENTS UNDER IMMERSION

L. N. KORNILOVA, O. N. KLUSHNIKOVA, L. B. KORSUNSKII, and B. G. KOZLOVA (Institute of Biomedical Problems, Moscow, Russia) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-218, S-219. refs

Results are presented from three series of experiments performed to investigate the eye movements during immersion, which are stimulated by additional proprioceptive, optokinetic, and vestibular-optokinetic inputs. The electrooculographic tests of the first series involved assessments of the role of the additional support (AS) in immersion tank. The second-series experiments involve testing subjects during free immersion and after an additional optokinetic stimulation input by stripped projections of a light beam. In the third series of tests, the subjects were tested with the same intervals, first, during free immersion and after

additional vestibulo-optokinetic stimulation consisting of head oscillations performed for 10 min with an amplitude of 45 deg in the frontal plane with a frequency of 0.5 Hz. I.S.

A92-39210

SENSORY INTERACTION AND METHODS OF NON-MEDICINAL PROPHYLAXIS OF SPACE MOTION SICKNESS

G. S. AIZIKOV, I. V. KREIDICH, and R. A. GRIGORIAN (Institute of Biomedical Problems, Moscow, Russia) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) *Physiologist, Supplement* (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-220 to S-223. refs

Data are presented from experiments on animals and humans, demonstrating the peculiarity of sensory interaction under varying experimental conditions including microgravity. These experiments included studies on the effects of electromyostimulation, vibrostimulation, and voluntary muscle tension on the toleration of Coriolis rotation test; studies of the comparative effects of drug (scopolamine), and nondrug (autotraining with feedback and voluntary muscular tension) prophylactic methods against experimental motion sickness; and studies of the effect of the compensation support unloading induced by microgravity. I.S.

A92-39212

SIMULATION OF THE EFFECT OF MICROGRAVITY ON THE HUMAN BODY BY ITS PROLONGED ROTATION ABOUT THE HORIZONTAL LOCATED LONG AXIS

A. M. GENIN, V. G. GOFF, I. B. KOZLOVSKAIA, G. G. LEZHAVA, E. I. MATSNEV, and V. M. OKUDZHAHA (Institute of Biomedical Problems, Moscow, Russia) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) *Physiologist, Supplement* (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-226, S-227. refs

The widely used methods developed for simulating microgravity effects are discussed, including methods for simulating the effects of microgravity on blood circulation, fluid/electrolyte balance, and metabolism as well as methods that simulate the vestibular effects (e.g., Coriolis acceleration cumulation tests, slowly rotating room, and Khilov swing). Special attention is given to a little-used model, called VEGA device, of vestibular effects that involves uniform rotation of a subject about the horizontal axis. It is shown that this model simulates certain manifestations of space motion sickness, including the disorientation in the gravitational field, nausea and occasional vomiting, and enhanced diuresis. Human subjects exposed to VEGA rotation also reported of reduced tactile perception and induced illusory sensation of body 'loss'. I.S.

A92-39214

PERSPECTIVES FOR THE APPLICATION OF THE PENAZ'S METHOD FOR A NON-INVASIVE CONTINUOUS BLOOD PRESSURE MEASUREMENT IN SPACE MEDICINE

L. NOVAK, J. PENAZ (Masarik University, Brno, Czechoslovakia), A. R. KOTOVSKAIA, I. F. VIL'-VIL'YAMS, V. I. LUK'IANIUK, and G. F. NIKOLASHIN (Institute of Biomedical Problems, Moscow, Russia) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) *Physiologist, Supplement* (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-230, S-231.

The feasibility of using the Penaz (1973) method of continuous noninvasive arterial pressure (AP) measurements for predicting health impairments in humans under gravitational blood redistribution was investigated in subjects exposed to one of the following conditions: (1) +Gz acceleration in a human centrifuge, (2) tilt-table rest, and (3) low body negative pressure (LBNP). The patterns of AP monitoring were obtained according with the Penaz method, using an instrument (Servotonometer) developed for this method. The analysis of data on the dynamics of AP in subjects undergoing gravitational blood redistribution demonstrates that the Penaz method makes it possible to continuously obtain information

on the systolic, diastolic, and pulsive APs; it gives an opportunity to assess the effects of cardiac-rhythm disturbances on the hemodynamics; and makes it possible to predict a subject's health condition during gravitational blood redistribution. I.S.

A92-39978* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

ALERTNESS MANAGEMENT IN FLIGHT OPERATIONS - STRATEGIC NAPPING

MARK R. ROSEKIND (NASA, Ames Research Center, Moffett Field, CA), PHILIPPA H. GANDER (San Jose State University Foundation; NASA, Ames Research Center, Moffett Field, CA), and DAVID F. DINGES (Pennsylvania, University, Philadelphia) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 14 p. refs

(SAE PAPER 912138) Copyright

Strategic napping in two different flight operation environments is considered to illustrate its application as a fatigue countermeasure. Data obtained from commercial short-haul and long-haul operations demonstrated the utility and current practices of strategic napping. A preplanned cockpit nap acted as an acute 'safety valve' for the sleep loss, circadian disruption, and fatigue that occurs in long-haul flying. O.G.

A92-40624

DISTURBANCES IN CEREBRAL HEMODYNAMICS IN ACUTE MOUNTAIN SICKNESS [NARUSHENIA TSEREBRAL'NOI GEMODINAMIKI PRI OSTROI GORNOI BOLEZNI]

S. I. SOROKO (AN Kyrgyzstana, Institut Fiziologii i Eksperimental'noi Patologii Vysokogor'ia, Bishkek, Kyrgyzstan) and I. A. SIDOROV (Institut Eksperimental'noi Meditsiny, St. Petersburg, Russia) *Fiziologiya Cheloveka* (ISSN 0131-1646), vol. 18, no. 2, Mar.-Apr. 1992, p. 81-88. In Russian. refs

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Results are presented from 3-yr-long clinical observations of a subject suffering from aftereffects of acute mountain sickness in severe form, contracted at the altitude of 3000 m in Antarctica. The tests (performed on day 15, 20, 35, 47, and 65 from the start of the illness and every 6 months afterward for three years) included rheoencephalography, nitroglyceride tests, and measurements of the blood pressure changes in the cerebral hemispheres and in selected individual arteries. Results showed that the initial stage of the sickness was characterized by an increase of blood filling in cerebral hemispheres, accompanied by decreases in tonicity and elasticity of individual cerebral vessels and the appearance of brain edema. The recovery process took a wavelike form and, during the two months when the subject remained in Antarctica, failed to stabilize. The return home accompanied by chemotherapy brought about almost complete recovery after 2.5 yrs. I.S.

A92-40625

ANALYSIS OF CHANGES IN THE CARDIAC RHYTHM OF HUMAN OPERATORS, USING A MODEL FOR SUCCESSFUL AND MONOTONOUS TRACKINGS OF A TARGET AND IN THE CASE OF UNSUCCESSFUL TRACKING [ANALIZ IZMENENII SERDECHNOGO RITMA CHELOVEKA-OPERATORA NA MODELI USPESHNOGO MONOTONNOGO SLEZHENIIA ZA TSEL'JU I PRI SBOE V RABOTE]

I. N. SAMKO, N. IA. BATOVA, and A. A. TIUNOVA (NII Normal'noi Fiziologii, Moscow, Russia) *Fiziologiya Cheloveka* (ISSN 0131-1646), vol. 18, no. 2, Mar.-Apr. 1992, p. 149-152. In Russian. refs

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Results are presented of a mathematical analysis of the cardiac rhythm spectra of human operators performing purposeful tasks that could be successfully completed or could not be completed due to a malfunction or an interruption. The analyses revealed the occurrences of peaks in the cardiac rhythm following phases of instruction and due to interruptions. I.S.

A92-40753

A STUDY OF THE MECHANISMS REGULATING THE STATE OF OPERATORS ENGAGED IN CONTINUOUS ACTIVITY, USING A METHOD THAT REGISTERS FORESTALLING LATERAL EYE MOVEMENTS [ISSLEDOVANIE MEKHANIZMOV REGULIATSII SOSTOIANIIA OPERATOROV V KHODE REZHIMA NEPRERYVNOI DEIATEL'NOSTI METODOM REGISTRATSII LATERAL'NYKH OPEREZHAIUSHCHIKH DVIZHENII GLAZI]

E. G. UDACHINA (Rossiiskaia Akademiia Nauk, Institut Psikhologii, Moscow, Russia) Fiziologiya Cheloveka (ISSN 0131-1646), vol. 18, no. 1, Jan.-Feb. 1992, p. 51-55. In Russian. refs

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The functional asymmetry of cerebral hemispheres was examined as one of the mechanisms of adaptation and self-regulation in operators working continuously without sleep by measuring changes in the characteristics of forestalling lateral eye movements as indices of hemispheric activation. It is shown that prolonged continuous sleep deprivation brings about a change in the activation relationship between the right and the left cerebral hemispheres, reflecting a change in the type of interhemispheric regulation. I.S.

A92-40754

AN ANALYSIS OF SCALES USED FOR MEASURING GALVANIC SKIN RESPONSES IN HUMANS [ANALIZ SHKAL, PRIMENIAEMYKH DLIA IZMERENII KOZHNO-GAL'VANICHESKIKH REAKTSII CHELOVEKA]

V. V. SUKHODOEV (Rossiiskaia Akademiia Nauk, Institut Psikhologii, Moscow, Russia) Fiziologiya Cheloveka (ISSN 0131-1646), vol. 18, no. 1, Jan.-Feb. 1992, p. 56-63. In Russian. refs

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The effect of the level of the galvanic skin-response (GSR) signal in humans on the values of the GSR signal changes during the subject's activity and on the amplitudes of physical reaction was investigated. The logarithmic scale developed on the basis of experimental data obtained in this work for the measurements of changes in the GSR signal is compared with two traditional scales: a scale of the electrical conductivity in the skin (ECS) and a scale of skin electrical resistance of skin (SER). It is shown that of both these widely used scales are deficient. The main deficiency of the ECS and SER scales is an inadequate assessment of the GSR by subjects with individually different levels of the GSR signal. I.S.

A92-40755

HIGH-ALTITUDE ADAPTATION AND PHYSICAL WORK CAPACITY [VYSOKOGORNAIA ADAPTATSIIA I FIZICHESKAIA RABOTOSPOSOBNOST']

S. G. KRIVOSHCHIEV, T. V. NESHUMOVA, and A. A. RAZUMENKO (Rossiiskaia AMN, Institut Fiziologii, Novosibirsk, Russia) Fiziologiya Cheloveka (ISSN 0131-1646), vol. 18, no. 1, Jan.-Feb. 1992, p. 64-68. In Russian. refs

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New data are presented on residual effects of the high-altitude adaptation remaining in athletes after spending one month in the Pamir mountains at altitudes between 3000 and 5000 m. It is shown that, following their return to a lowland region, the subjects exhibited increased levels in the efficiency of the muscle activity, decreased losses of body heat after performing physical work of medium intensity, and a lowered aerobic capacity in cases of high-intensity work. Mechanisms responsible for these changes are discussed. I.S.

A92-40756

NEURODYNAMIC INDICATORS OF HIGH-ALTITUDE ADAPTATION EFFICIENCY IN HUMANS [NEIRODINAMICHESKIE POKAZATELI EFFEKTIVNOSTI ADAPTATSII CHELOVEKA K VYSOKOGOR'IU]

F. A. SHUKUROV and V. P. MESHCHERIAKOV (Tadzhikskii Gosudarstvennyi Meditsinskii Institut, Dushanbe, Tajikistan)

Fiziologiya Cheloveka (ISSN 0131-1646), vol. 18, no. 1, Jan.-Feb. 1992, p. 69-75. In Russian. refs

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A method is described for studying the conditional-reflect rearrangements in the respiratory, visual, and cardiovascular systems, making it possible to investigate neuronal mechanisms of high-altitude adaptation. Results obtained with this method were used to identify the neurodynamical basis of the capability of humans for adapting to high altitudes, and to establish criteria for predicting the level of the high-altitude adaptability of an individual. I.S.

A92-40757

THE EFFECT OF FLUORINE SUPPLEMENT ON ADAPTIVE REACTIONS OF THE HEART DURING EXPOSURES TO COLD [VLIANIE MIKROELEMENTA FTORA NA ADAPTIVNYE REAKTSII SERDTSIA PRI KHOLODOVOM VOZDEISTVII NA ORGANIZM]

IU. R. TEDDER and A. V. GRIBANOV (Arkhangel'skii Gosudarstvennyi Meditsinskii Institut, Arkhangelsk, Russia) Fiziologiya Cheloveka (ISSN 0131-1646), vol. 18, no. 1, Jan.-Feb. 1992, p. 141-145. In Russian. refs

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The effect of fluorine as a dietary supplement on the ability of the heart to adapt to cold was investigated by measuring electromechanical characteristics of the cardiac activity in rats that for 6 weeks received drinking water containing either insufficient (0.2 mg/l) or optimal (1.5 mg/l) quantities of fluorine. During this period, the rats were daily exposed to cold (5 hrs at 5 C) and their cardiac activity was analyzed using electrocardiography and kinetocardiography. Rats receiving insufficient fluorine supplement showed deterioration of cardiac functional activity upon exposures to cold. I.S.

A92-40931

PHYSIOLOGICAL RESPONSE TO PRESSURE BREATHING WITH A CAPSTAN COUNTER PRESSURE VEST

HUA J. XIAO and DENG Y. HE (Institute of Aviation Medicine, Beijing, People's Republic of China) SAFE Journal, vol. 21, no. 5, 1991; vol. 22, no. 1, 1992, p. 20-22. refs

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The physiological response and tolerance to the positive pressure breathing (PPB) under the higher pressures with a capstan pressure vest were evaluated. Eight subjects undertook the PPB with different pressure from 6.37 to 8.33 KPa at altitudes from 15 Km to 16.5 Km. Each of the subjects was wearing the fitted oxygen mask, the capstan vest, and the anti-G suit which was not linked together with the oxygen regulator. The test results demonstrate that the PPB of 6.37 to 8.33 KPa with the counterpressure vest were well tolerated, although the pressure of PPB in this study was higher than that of other authors. The decrease in stroke volume was obvious, since no counter pressure on the legs was applied, therefore, blood pooled in the lower body. The capstan pressure vest could be used only for short intervals of 'get-me-down'. Author

N92-24672# Los Alamos National Lab., NM.

ELECTROMAGNETIC IMAGING OF DYNAMIC BRAIN ACTIVITY

J. MOSHER, R. LEAHY, P. LEWIS, J. LEWINE, J. GEORGE, and M. SINGH (University of Southern California, Los Angeles.) 1991 5 p Presented at the IEEE Nuclear Science Symposium, Santa Fe, NM, 5-9 Nov. 1991

(Contract W-7405-ENG-36)

(DE92-005017; LA-UR-91-3870; CONF-911106-56) Avail: NTIS HC/MF A01

Neural activity in the brain produces weak dynamic electromagnetic fields that can be measured by an array of sensors. Using a spatio-temporal modeling framework, we have developed a new approach to localization of multiple neural sources. This approach is based on the MUSIC algorithm originally developed for estimating the direction of arrival of signals impinging on a sensor array. We present applications of this technique to magnetic

field measurements of a phantom and of a human evoked somatosensory response. The results of the somatosensory localization are mapped onto the brain anatomy obtained from magnetic resonance images. DOE

N92-24899# Mount Sinai School of Medicine, New York, NY. Dept. of Physiology and Biophysics.

MOLECULAR MECHANISMS IN RADIATION DAMAGE TO DNA

R. OSMAN 28 Oct. 1991 2 p

(Contract DE-FG02-88ER-60675)

(DE92-008799; DOE/ER-60675/5) Avail: NTIS HC/MF A01

The objectives of this work are to elucidate the molecular mechanisms that are responsible for radiation-induced DNA damage. The overall goal is to understand the relationship between the chemical and structural changes produced by ionizing radiation in DNA and the resulting impairment of biological function expressed as carcinogenesis or cell death. The studies are based on theoretical explorations of possible mechanisms that link initial radiation damage in the form of base and sugar damage to conformational changes in DNA. These mechanistic explorations should lead to the formulation of testable hypothesis regarding the processes of impairment of regulation of gene expression, alternation in DNA repair, and damage to DNA structure involved in cell death or cancer. DOE

N92-25045# Brookhaven National Lab., Upton, NY.

MEDICAL APPLICATIONS OF SYNCHROTRON RADIATION

W. THOMLINSON Oct. 1991 26 p Presented at the 7th

National Conference and Exhibition on Synchrotron Radiation Instrumentation, Baton Rouge, LA, 28-31 Oct. 1991

(Contract DE-AC02-76CH-00016)

(DE92-005041; BNL-46865; CONF-9110146-5) Avail: NTIS HC/MF A03

Ever since the first diagnostic x-ray was done in the United States on 3 Feb. 1896, the application of ionizing radiation to the field of medicine has become increasingly important. Both in clinical medicine and basic research the use of x-rays for diagnostic imaging and radiotherapy is now widespread. Radiography, angiography, CAT and PETT scanning, mammography, and nuclear medicine are all examples of technologies developed to image the human anatomy. In therapeutic applications, both external and internal sources of radiation are applied to the battle against cancer. The development of dedicated synchrotron radiation sources has allowed exciting advances to take place in many of these applications. The new sources provide tunable, high-intensity monochromatic beams over a wide range of energies which can be tailored to specific programmatic needs. This paper surveys those areas of medical research in which synchrotron radiation facilities are actively involved. DOE

N92-25046# Lawrence Livermore National Lab., CA.

ABSOLUTE CALIBRATION OF IN VIVO MEASUREMENT SYSTEMS USING MAGNETIC RESONANCE IMAGING AND MONTE CARLO COMPUTATIONS

M. W. MALLET (Texas A&M Univ., College Station.), D. P. HICKMAN, and D. A. KRUCHTEN 1991 4 p Presented at the 8th International Radiation Protection Association Conference, Montreal, Quebec, 17-22 May 1992

(Contract W-7405-ENG-48)

(DE92-005253; UCRL-JC-106915; CONF-920501-14) Avail: NTIS HC/MF A01

Lawrence Livermore National Laboratory (LLNL) is currently investigating a new method for obtaining absolute calibration factors for radiation measurement systems used to measure internally deposited radionuclides in vivo. This method uses magnetic resonance imaging (MRI) to determine the anatomical makeup of an individual. A new MRI technique is also employed that is capable of resolving the fat and water content of the human tissue. This anatomical and biochemical information is used to model a mathematical phantom. Monte Carlo methods are then used to simulate the transport of radiation throughout the phantom. By modeling the detection equipment of the in vivo measurement system into the code, calibration factors are generated that are

specific to the individual. Furthermore, this method eliminates the need for surrogate human structures in the calibration process. A demonstration of the proposed method is being performed using a fat/water matrix. DOE

N92-25304# Technische Univ., Delft (Netherlands).

IN-VIVO PROTON MAGNETIC RESONANCE SPECTROSCOPY: EVALUATION OF MULTIPLE QUANTUM TECHNIQUES FOR SPECTRAL EDITING AND A TIME DOMAIN FITTING PROCEDURE FOR QUANTIFICATION Ph.D. Thesis

JOHANNES EDWINUS VANDIJK 1991 154 p

(ETN-92-91283) Avail: NTIS HC/MF A08

Several aspects concerning the use of multiple quantum coherence techniques for in vivo studies are detailed. It is shown that a zero quantum sequence can be used to selectively measure lactate and that this sequence can be combined with a localization technique. Editing techniques to separate signals from two complex spin systems (glutamate and glutamine) are described. Since it appeared to be very difficult to selectively measure one of these systems and suppress the other with multiple quantum coherence techniques, an alternative method is also given. Pathophysiological mechanisms responsible for the induction of hepatic encephalopathy are studied. A study in which an editing sequence is used to detect lactate, and a nonediting sequence is used to measure the complete spectrum is performed. Data processing techniques are addressed. The incorporation of knowledge in a Gauss-Newton iterative fitting procedure is described and it is shown how actual prior knowledge can be obtained and used to analyze a signal consisting of damped sinusoids which in the frequency domain severely overlap. The method is used to fit, frequency selectively, real in vivo signals. ESA

N92-25422# Colorado Univ., Boulder. Dept. of Pharmacology.

THE CDNA EXPRESSION MAP OF THE HUMAN GENOME: METHODS DEVELOPMENT AND APPLICATIONS USING BRAIN CDNAS

J. M. SIKELA 1991 4 p

(Contract DE-FG02-91ER-61241)

(DE92-005520; DOE/ER-61241/1) Avail: NTIS HC/MF A01

The following describes the progress on human brain cDNA sequencing and mapping that our laboratory has made over the past few months. It should be noted that our first funding installment for the first phase of this grant was obtained approximately two weeks ago. Therefore, the progress that is described represents efforts that were carried out without DOE Genome funds and thus largely are a continuation of pilot studies we began last year. We anticipate, now that DOE funds have arrived, that we will be able to significantly scale up our efforts and productivity. DOE

N92-25435# National Inst. for Occupational Safety and Health, Cincinnati, OH.

PROCEEDINGS OF THE SCIENTIFIC WORKSHOP ON THE HEALTH EFFECTS OF ELECTRIC AND MAGNETIC FIELDS ON WORKERS

P. J. BIERBAUM and J. M. PETERS 30 Jan. 1991 233 p Workshop held in Cincinnati, OH, 30-31 Jan. 1991

(PB92-131721; DHHS/PUB/NIOSH-91-111) Avail: NTIS HC/MF A11

Participants in the workshop discussed various aspects of the health effects on workers exposed to electric and magnetic fields. Specific topics discussed included low frequency electromagnetic fields, biological effects of extremely low frequency electromagnetic fields, health effects of exposures, occupational exposure assessment for electric and magnetic fields in the 10 to 1000 hertz frequency range, and magnetic field management. Research recommendations from workshop panels concerning in-vitro/cellular mechanism studies, exposure assessments, and methods for reducing exposures were provided. Author

N92-25481# Brookhaven National Lab., Upton, NY.

MONOCHROMATIC COMPUTED TOMOGRAPHY OF THE HUMAN BRAIN USING SYNCHROTRON X RAYS: TECHNICAL FEASIBILITY

E. NACHALIEL, F. A. DILMANIAN, R. F. GARRETT, W. C. THOMLINSON, L. D. CHAPMAN, N. F. GMUER, N. M. LAZARZ, H. R. MOULIN, M. L. RIVERS, H. RARBACK et al. 1991 25 p Presented at the 7th National Conference and Exhibition on Synchrotron Radiation Instrumentation, Baton Rouge, LA, 28-31 Oct. 1991

(Contract DE-AC02-76CH-00016)

(DE92-007143; BNL-47068; CONF-9110146-7) Avail: NTIS HC/MF A03

A monochromatic computed tomography (CT) scanner is being developed at the X17 superconducting wiggler beamline at the National Synchrotron Light Source (NSLS), Brookhaven National Laboratory, to image the human head and neck. The system configuration is one of a horizontal fan beam and an upright seated rotating subject. The purpose of the project is to demonstrate improvement in the image contrast and in the image quantitative accuracy that can be obtained in monochromatic CT and to apply the system to specific clinical research programs in neuroradiology. This paper describes the first phantom studies carried out with a prototype system, using the dual photon absorptiometry (DPA) method at energies of 20 and 39 KeV. The results show that improvements in image contrast and quantitative accuracy are possible with monochromatic DPA CT. Estimates of the clinical performance of the planned CT system are made on the basis of these initial results. DOE

N92-25508# Oak Ridge National Lab., TN.

RADIATION EFFECTS IN SPACE: RESEARCH NEEDS

R. J. M. FRY 1991 5 p Presented at the 9th International Congress of Radiation Research (ICRR) Conference, Toronto, Ontario, 7-12 Jul. 1991

(Contract DE-AC05-84OR-21400)

(DE92-006597; CONF-9107136-9) Avail: NTIS HC/MF A01

At the 8th International Congress of Radiation Research an account was given of the findings of the National Council on Radiation Protection and Measurements (NCRP) on radiation environments in space and their estimates of dose equivalents. The committee gave guidance about possible career limits of exposure to radiation during low earth orbits based on risk estimates available at the time. The information about deep space was insufficient to estimate the risks for missions into deep space. It was known that new risk estimates and recommendations of dose limits for terrestrial workers were on the way, and they are now available. The NCRP has started to reassess the radiation risks in space. The gaps in the information about salient aspects of the effects of the space radiation required for predicting the radiation risks, especially for deep space missions, are apparent and are the subject of this paper. DOE

N92-25743# Adelaide Children's Hospital, North Adelaide (Australia)

CORRELATION OF PHYSICAL AND GENETIC MAPS OF HUMAN CHROMOSOME 16

G. R. SUTHERLAND 1991 8 p

(Contract DE-FG02-89ER-60863)

(DE92-007547; DOE/ER-60863/3) Avail: NTIS HC/MF A02

This project aimed to divide chromosome 16 into approximately 50 intervals of approx. 2Mb in size by constructing a series of mouse/human somatic cell hybrids each containing a rearranged chromosome 16. Using these hybrids, DNA probes would be regionally mapped by Southern blot or PCR analysis. Preference would be given to mapping probes which demonstrated polymorphisms for which the CEPH panel of families had been typed. This would allow a correlation of the physical and linkage maps of this chromosome. The aims have been substantially achieved. Some 49 somatic cell hybrids have been constructed which have allowed definition of 46, and potentially 57, different physical intervals on the chromosome. Some 164 loci have been fully mapped into these intervals. A correlation of the physical and genetic maps of the chromosome is in an advanced stage of preparation. The somatic cell hybrids constructed have been widely distributed to groups working on chromosome 16 and other genome projects. DOE

N92-25989# Brookhaven National Lab., Upton, NY.

A SURVEY OF MEDICAL DIAGNOSTIC IMAGING TECHNOLOGIES

V. HEESE, N. GMUER, and W. THOMLINSON Oct. 1991 86 p (Contract DE-AC02-76CH-00016)

(DE92-007633; BNL-46739) Avail: NTIS HC/MF A05

The fields of medical imaging and medical imaging instrumentation are increasingly important. The state-of-the-art continues to advance at a very rapid pace. In fact, various medical imaging modalities are under development at the National Synchrotron Light Source (such as MECT and Transvenous Angiography.) It is important to understand how these techniques compare with today's more conventional imaging modalities. The purpose of this report is to provide some basic information about the various medical imaging technologies currently in use and their potential developments as a basis for this comparison. This report is by no means an in-depth study of the physics and instrumentation of the various imaging modalities; instead, it is an attempt to provide an explanation of the physical bases of these techniques and their principal clinical and research capabilities. DOE

N92-25993# Los Alamos National Lab., NM.

LASER-INDUCED CONTAINED-VAPORIZATION IN TISSUE

R. S. DINGUS 1992 9 p Presented at the Society of Photo-Optical Instrumentation Engineers International Symposium on Laser Spectroscopy as part of SPIE's Symposium on Optics, Electro-Optics and Laser Applications in Science and Engrg., Los Angeles, CA, 19-24 Jan. 1992

(Contract W-7405-ENG-36)

(DE92-008446; LA-UR-92-363; CONF-920124-11) Avail: NTIS HC/MF A02

When a transparent liquid or solid medium is present in front of an opaque target being irradiated by an intense laser beam, then the expansion of hot vapors generated (at the interface between the medium and the target) by the irradiant heating of the target is restrained by the medium. The tamping effect of the overlying liquid or solid can cause a much larger fraction of the deposited energy to go into kinetic energy, which leads to enhanced tissue disruption, compared to when a gas or vacuum is in front of the target. Condensable vapors and high thermal conductivity in the surrounding material facilitate rapid energy transport out of the vapor, which can cause a major reduction in the tamping enhancements. This contained-vaporization process is likely important in laser-medical applications such as, for example, laser angioplasty and laser lithotripsy. The work enhancement by the process is probably advantageous for lithotripsy in providing the necessary energy to break urinary stones; however, for angioplasty, the enhancement may provide little aid in removing plaque but may cause significant damage to arterial walls. If gas could be introduced into the artery proceeding irradiation of the plaque, then the enhancements could be avoided. In summary, careful management of the tamping conditions during tissue irradiations in the clinical applications of lasers should lead to significant improvements in the overall desired outcome. DOE

N92-26030*# Brown Univ., Providence, RI. Dept. of Pathology **MECHANICAL STIMULATION OF SKELETAL MUSCLE GENERATES LIPID-RELATED SECOND MESSENGERS BY PHOSPHOLIPASE ACTIVATION**

HERMAN H. VANDENBURGH, JANET SHANSKY, PATRICIA KARLISCH, and ROSA LOPEZ SOLERSSI 1991 50 p Prepared in cooperation with Miriam Hospital, Providence, RI

(Contract NAG2-414; NIH-AR-39998)

(NASA-CR-190158; NAS 1.26:190158) Avail: NTIS HC/MF A03

Repetitive mechanical stimulation of cultured avian skeletal muscle increases the synthesis of prostaglandins E2 and F2(alpha) which regulate protein turnover rates and muscle cell growth. Mechanical stimulation significantly increases the breakdown rate of (3)H-arachidonic acid labelled phospholipids, releasing free (3)H-arachidonic acid, and the rate-limiting precursor of prostaglandin synthesis. Mechanical stimulation also significantly increases (3)H-arachidonic acid labelled diacylglycerol formation

and intracellular levels of inositol phosphates from myo-2-(3)H inositol labelled phospholipids. Phospholipase A2, phosphatidylinositol-specific phospholipase C (PLC), and phospholipase D (PLD) are activated by stretch. The lipase inhibitors bromophenacylbromide and RHC80267 together reduce stretch-induced prostaglandin production by 73-83 percent. The stretch-induced increases in prostaglandin production, (3)H-arachidonic acid labelled phospholipid breakdown, and (3)H-arachidonic acid labelled diacylglycerol formation occur independently of cellular electrical activity (tetrodotoxin insensitive) whereas the formation of inositol phosphates from myo-2-(3)H inositol labelled phospholipids are dependent on cellular electrical activity. These results indicate that mechanical stimulation increases the lipid-related second messengers arachidonic acid, diacylglycerol, and prostaglandins through activation of specific phospholipases such as PLA2 and PLD, but not by activation of phosphatidylinositol-specific PLC. Author

53

BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

A92-37173

TYROSINE AND ITS POTENTIAL USE AS A COUNTERMEASURE TO PERFORMANCE DECREMENT IN MILITARY SUSTAINED OPERATIONS

JOSEPH O. OWASOYO, DAVID F. NERI, and JOHN G. LAMBERTH (U.S. Navy, Naval Aerospace Medical Research Laboratory, Pensacola, FL) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 63, no. 5, May 1992, p. 364-369. Research sponsored by U.S. Navy. refs Copyright

The biochemistry and physiological role of the amino acid tyrosine in normal and stressful situations such as military sustained operations are reviewed. Sustained operations consist of continuous work periods exceeding 12 h and often involve sleep loss and fatigue. These, in turn, can lead to stress, anxiety, mood deterioration, and performance decrement. Experimental data in the literature suggest that tyrosine, a precursor of the neuro-transmitter norepinephrine, may be useful in counteracting any stress-related performance decrement and mood deterioration in the following way. First, various forms of stress induce brain depletion of catecholamines, especially norepinephrine, in animals. Second, brain norepinephrine levels are closely related to stress-induced performance decrement in animals. Third, the administration of tyrosine may minimize or reverse stress-induced performance decrement by increasing depleted brain norepinephrine levels. The types of performance degradation expected in military sustained operations and the potential physiological role tyrosine might play in improving mood and performance are discussed. Author

A92-37476

A COMPUTER-AIDED APTITUDE TEST FOR PREDICTING FLIGHT PERFORMANCE OF TRAINEES

KYUNG S. PARK and SANG W. LEE (Korea Advanced Institute of Science and Technology, Seoul, Republic of Korea) Human Factors (ISSN 0018-7208), vol. 34, no. 2, April 1992, p. 189-204. Research sponsored by Korean Air Force. refs Copyright

Perceptual/psychomotor and cognitive tasks in a computer-aided aptitude test were studied to predict the success of a trainee in flight training. Pilots' tasks were tentatively classified into five categories: tracking, reaction, memory, estimation, and visual scanning. To investigate the performance of a trainee in these categories, 16 single tasks and 10 dual tasks were examined. In the factor analyses three common factors (tracking, reaction,

and memory) were meaningfully extracted. To select significant tasks for predicting flight performance the study employs stepwise regression and discriminate analyses. In the regression analyses, memory tasks were most significant in predicting the flight performance of a trainee. In the discriminate analyses, tracking tasks were most significant for distinguishing the passing and failing groups. Author

A92-38124* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

RHESUS MONKEY (MACACA MULATTA) COMPLEX LEARNING SKILLS REASSESSED

DAVID A. WASHBURN and DUANE M. RUMBAUGH (Georgia State University, Atlanta) International Journal of Primatology (ISSN 0164-0291), vol. 12, no. 4, 1991, p. 377-388. Research supported by Georgia State University. refs (Contract NAG2-438) Copyright

An automated computerized testing facility is employed to study basic learning and transfer in rhesus monkeys including discrimination learning set and mediational learning. The data show higher performance levels than those predicted from other tests that involved compromised learning with analogous conditions. Advanced transfer-index ratios and positive transfer of learning are identified, and indications of mediational learning strategies are noted. It is suggested that these data are evidence of the effectiveness of the present experimental apparatus for enhancing learning in nonhuman primates. C.C.S.

A92-38157* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

CREW FACTORS IN THE AEROSPACE WORKPLACE

BARBARA G. KANKI (NASA, Ames Research Center, Moffett Field, CA) and H. C. FOUSHEE (FAA, Washington, DC) IN: People's reactions to technology in factories, offices, and aerospace. Newbury Park, CA, Sage Publications, 1990, p. 203-241. refs Copyright

The effects of technological change in the aerospace workplace on pilot performance are discussed. Attention is given to individual and physiological problems, crew and interpersonal problems, environmental and task problems, organization and management problems, training and intervention problems. A philosophy and conceptual framework for conducting research on these problems are presented and two aerospace studies are examined which investigated: (1) the effect of leader personality on crew effectiveness and (2) the working undersea habitat known as Aquarius. C.D.

A92-38382

PILOT DISORIENTATION AS THE MOST FREQUENT CAUSE OF FATAL, WEATHER-RELATED ACCIDENTS IN UK CIVIL AND GENERAL AVIATION

WILLIAM S. PIKE Journal of Navigation (ISSN 0373-4633), vol. 45, no. 2, May 1992, p. 229-240. refs Copyright

An overview is presented that concentrates on pilot disorientation as being the most commonly reported cause of fatal weather-related civil aircraft accidents in the UK. During an analysis of UK general and civil aviation weather-related aircraft accidents, it was found that 39 of the 46 fatal accidents reported during the decade 1977-1986 had been at least partly caused by various forms of pilot disorientation in low cloud, fog and/or heavy precipitation. The three factors most commonly involved in major civil aviation accidents are the pilot's visual flight in IFR conditions, crew navigational error, and a pilot's failure to react correctly to new circumstances resulting from air traffic control instructions or advice. R.E.P.

A92-38626*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

ANALOG ENVIRONMENTS IN SPACE HUMAN FACTORS

MARY M. CONNORS (NASA, Ames Research Center, Moffett Field,

CA) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 10 p. refs
(AIAA PAPER 92-1527) Copyright

An account is given of what has been learned from space analog environments, which mimic such significant features of space as isolation, confinement, risk, and deprivation; emphasis is placed on the especially successful environments constituted by extended submarine research, undersea habitats, and Antarctic station wintering. Attention is also given to the advantages and limitations of the use of analog environments for space human factors research, and possibilities for such research efforts' management. O.C.

A92-38630*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

TEAM DYNAMICS IN ISOLATED, CONFINED ENVIRONMENTS - SATURATION DIVERS AND HIGH ALTITUDE CLIMBERS

BARBARA G. KANKI (NASA, Ames Research Center, Moffett Field, CA) and STEVEN E. GREGORICH (San Jose State University Foundation, Moffett Field, CA) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 11 p. refs
(AIAA PAPER 92-1531) Copyright

The effects of leadership dynamics and social organization factors on team performance under conditions of high altitude climbing and deep sea diving are studied. Teams of two to four members that know each other well and have a relaxed informal team structure with much sharing of responsibilities are found to do better than military teams with more than four members who do not know each other well and have a formal team structure with highly specialized rules. Professionally guided teams with more than four members, a formally defined team structure, and clearly designated role assignments did better than 'club' teams of more than four members with a fairly informal team structure and little role specialization. C.D.

A92-38631#

ASSESSING HUMAN RELIABILITY IN SPACE - WHAT IS KNOWN, WHAT STILL IS NEEDED

LEE T. OSTROM, DAVID I. GERTMAN, and HAROLD S. BLACKMAN (Idaho National Engineering Laboratory, Idaho Falls) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 10 p. refs
(AIAA PAPER 92-1532) Copyright

A method for assessing human reliability in space is presented. This method integrates a model of stressors with a known human reliability assessment technique. A model of the types of stressors an astronaut might encounter in long space flight was taken from the experience of crews that have overwintered on Antarctica. The stressors were extreme weather, interpersonal conflicts, lack of communications with friends and family, lack of privacy, supply shortages, cramped quarters, and monotony in the environment. The technique for human error rate prediction (THERP) was selected to model and quantify the human error associated with different mission tasks. The trial application was successful and illustrates the need for a detailed task analysis of a Mars mission, estimates of the human error probabilities (HEPs) from simulator trials or the actual human reliability data from the Apollo missions, and an understanding of how the stressors encountered in space affect these HEPs. A discussion of the appropriateness of existing HRA methods and data is also presented. Author

A92-38697#

MULTI-CULTURAL CONSIDERATIONS FOR SPACE STATION TRAINING AND OPERATIONS

VEIT HANSSEN (Hanssen International, Seabrook, TX), WILLIAM STAYTON (Barrios Technology, Inc., Houston, TX), and MICHAEL WLAKA (Dornier GmbH, Friedrichshafen, Federal Republic of Germany) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 7 p.
(AIAA PAPER 92-1624) Copyright

The present discussion of Space Station Freedom program-related Extreme Environment Training (EET) gives

attention to cultural differences that can potentially create problems during EET, and explores those aspects of identified problems to which trainers can productively respond. These cultural differences cover the fields of native language, nonverbal communication, task-oriented behavior, assertiveness, decision-making processes, scheduling and time-management, patience and tolerance, interpersonal interest, relationship-oriented behavior, respect for foreign cultures, sensitivity to gender roles, and sense of humor. EET training must overcome any barriers to the achievement of team spirit. O.C.

A92-38698*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

SPACEFLIGHT TRAINING ISSUES - SHUTTLE VERSUS STATION

FRANK E. HUGHES (NASA, Johnson Space Center, Houston, TX) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 9 p.
(AIAA PAPER 92-1625) Copyright

A comparative study is made of the training practices used for Space Shuttle crews and those projected for the NASA Space Station Freedom, with a view to the relative advantages anticipated for these methods in the fields of long-duration flights, on-orbit construction techniques, on-orbit maintenance requirements, medical expertise, and remote manipulator operations. A Training Operations Subpanel has been established by NASA for the coordination of training method developments across the various elements and phases of the program. O.C.

A92-38700#

CREW TRAINING FOR PSYCHO-SOCIO ADAPTATION TO LONG DURATION MISSIONS

JOHN M. NICHOLAS (Loyola University, Chicago, IL) and LARRY W. PENWELL (Mary Washington College, Fredericksburg, VA) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 9 p. refs
(AIAA PAPER 92-1627) Copyright

Research from confined, isolated environments indicates that as the duration of space missions increase, the psycho-socio dynamics of crew behavior will become potential threats to crew safety and mission success. There have been few problems in space flight associated with crew psycho-socio behavior, but current and past missions have been of relatively short duration or involved small crews. Future missions will be of longer duration and greater crew size, factors in combination which will likely magnify the effects of confinement and isolation on behavior and performance. This paper describes a model for preparing crews to live and work effectively in long duration space flight. The model addresses salient psychological and social issues identified from research, and is complementary to the current program of astronaut technical training. Author

A92-38704#

SPACE STATION FREEDOM FLIGHT CREW INTEGRATION GROUND RULES AND CONSTRAINTS

DAVID LUBIN (McDonnell Douglas Space Systems Co., Houston, TX), CAROLYNN CONLEY, and JAMES W. BILODEAU (Eagle Engineering, Inc., Houston, TX) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 12 p. refs
(AIAA PAPER 92-1634) Copyright

A Mission/Function analysis procedure was developed and implemented in order to document the intended use of Space Station Freedom (SSF). The analysis addressed four aspects of current SSF design requirements and assumptions, including: (1) crew functions required for achieving end-to-end SSF mission objectives, (2) crew roles and responsibilities, (3) intended use of different work sites and stations which execute the different classes of crew functions, and (4) whether or not the work sites and stations are equipped adequately to support the intended use as defined by mission scenarios. At the conceptual level, this analysis indicated that the SSF systems and elements have been designed to meet station requirements which are adequate to meet the

station's intended use. However, operational constraints may be very restrictive. In general, data showed that during the man-tended phase, the flight crew will concentrate on assembly, activation and checkout of the systems and the payloads, while ground controllers will serve as the primary systems operators and mission planners. Author

A92-39136 National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
PERCEPTION OF LINEAR ACCELERATION IN WEIGHTLESSNESS

ANTHONY P. ARROTT, LAURENCE R. YOUNG, and DANIEL M. MERFELD (Payload Systems, Inc.; MIT, Cambridge, MA) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-40 to S-43. refs
 (Contract NAS9-15343; NASW-3651)

Tests of the perception and use of linear acceleration sensory information were performed on the science crews of the Spacelab 1 (SL-1) and D-1 missions using linear 'sleds' in-flight (D-1) and pre-post flight. The time delay between the acceleration step stimulus and the subjective response was consistently reduced during weightlessness, but was neither statistically significant nor of functional importance. Increased variability of responses when going from one environment to the other was apparent from measurements on the first day of the mission and in the first days post-flight. Subjective reports of perceived motion during sinusoidal oscillation in weightlessness were qualitatively similar to reports on earth. In a closed-loop motion nulling task, enhanced performance was observed post-flight in all crewmembers tested in the Y or Z axes. Author

A92-39152
EFFECT OF +GY STRESS ON PSYCHOPHYSIOLOGICAL PARAMETERS AND TRACKING PERFORMANCE IN HUMANS
 BAOSHENG XIE, ZHANGNIAN QI, YUEYING XUE, ZHENYONG XU, HUAYING XU, and GUANGYUAN LIU (Institute of Space Medico-Engineering, Beijing, People's Republic of China) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-84 to S-87. refs

The effect of lateral acceleration (+Gy) on various psychophysiological parameters (including mean heart rate, respiration rate, EEG theta wave, and the total energy of EMG of the forearm muscle group) and the tracking performance of humans was investigated in healthy subjects subjected to rides in a human centrifuge with 12-m radius; the +Gy stress was of trapezoidal profile having plateau levels of +1Gy, +2Gy, and +3Gy, with duration of 120 sec. Results of measurements of psychophysiological responses and of the tracking performance test showed that gravitational forces along the Y axis of human body had considerable effect on the psychophysiological functions and working performance. Possible causes of these effects are discussed. I.S.

A92-39307* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

POTENTIAL BENEFITS AND HAZARDS OF INCREASED RELIANCE ON COCKPIT AUTOMATION

EARL L. WIENER (Miami, University, Coral Gables, FL) IN: Safety at sea and in the air - Taking stock together; Proceedings of the Conference, London, England, Nov. 13-15, 1990. London, Royal Aeronautical Society, 1990, p. 15.1-15.7. refs
 (Contract NCC2-581; NCA2-441)
 Copyright

A review is presented of the introduction of advanced technology into the modern aircraft cockpit, bringing a new era of cockpit automation, and the opportunity for safe, fuel-efficient, computer-directed flight. It is shown that this advanced technology

has also brought a number of problems, not due to equipment failure, but due to problems at the human-automation interface. Consideration is given to the interface, the ATC system, and to company, regulatory, and economic environments, as well as to how they contribute to these new problems. R.E.P.

A92-39486
FAST PERCEPTUAL LEARNING IN VISUAL HYPERACUITY
 TOMASO POGGIO (MIT, Cambridge, MA), MANFRED FAHLE (Tuebingen, Universitaet, Federal Republic of Germany), and SHIMON EDELMAN (Weizmann Institute of Science, Rehovot, Israel) Science (ISSN 0036-8075), vol. 256, no. 5059, May 15, 1992, p. 1018-1021. Research supported by U.S. Navy, Hughes Aircraft Corp., DFG, and DARPA. refs
 Copyright

In many different spatial discrimination tasks, such as in determining the sign of the offset in a Vernier stimulus, the human visual system exhibits hyperacuity by evaluating spatial relations with the precision of a fraction of a photoreceptor's diameter. It is proposed that this impressive performance depends in part on a fast learning process that uses relatively few examples and that occurs at an early processing stage in the visual pathway. This hypothesis is given support by the demonstration that it is possible to synthesize, from a small number of examples of a given task, a simple network that attains the required performance level. Psychophysical experiments agree with some of the key predictions of the model. In particular, fast stimulus-specific learning is found to take place in the human visual system, and this learning does not transfer between two slightly different hyperacuity tasks. Author

A92-39953
A GENERAL AVIATION FLIGHT SIMULATION PARADIGM FOR THE 21ST CENTURY

DAVID A. LOMBARDO (Bowling Green State University, OH) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 7 p. refs
 (SAE PAPER 912096) Copyright

This paper outlines a paradigm for future civilian flight training that is divided into two phases of implementation. Phase I relies on a system which combines the emerging technology of the heavily dependent software-driven computer-based flight simulation (CBFS) and the more hardware dependent technology of flight training devices. Current technology exists to implement this initial phase and only awaits manufacturer acceptance of the concept. Phase II outlines the future of flight simulation based on the further refined CBFS system combined with the emerging technology of the highly sophisticated simulation capability of virtual reality. This phase is dependent upon successful continuance of current research and development in the area of virtual reality. Author

A92-39954
AIR TRAFFIC CONTROL SIMULATION TRAINING
 DEBORAH S. BRUCE (Systems, Requirements & Services Associates, Inc., Arlington, VA) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 10 p. refs
 (SAE PAPER 912097) Copyright

Simulation training of air traffic controllers will undergo major changes in the next few years. Central to the selection of a new ATC simulation training system is the issue of fidelity, both physical and functional. On the one hand, a very high level of fidelity is required to conduct advanced training in simulation labs rather than in the operational environment. However, the cost, particularly in staff resources, of providing and maintaining this level of realism limits its application to earlier phases of training. This paper recommends that the future simulation training system provide levels of fidelity appropriate to the level of training to which it is applied. This could be accomplished by either segmenting the capability of the full training system or through the provision of additional PC-based systems. Author

A92-39955

WHY SIMULATORS ARE MORE DIFFICULT TO FLY THAN AIRCRAFT

AMNON KATZ (Alabama, University, Tuscaloosa) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 8 p. refs
(SAE PAPER 912098) Copyright

Simulators are typically more difficult to fly than the aircraft they represent. The factors involved include limited field of view, degraded visual acuity, scene distortion, absence of depth perception, attenuation or absence of motion cues, and response delays that are often inconsistent among visual, motion, and instruments. It is suggested that for most training tasks the added difficulty because of these factors is not a drawback, and should not be alleviated at the expense of dynamic fidelity. Author

A92-39956

SIMULATOR SCENE DETAIL AND VISUAL AUGMENTATION GUIDANCE IN LANDING TRAINING FOR BEGINNING PILOTS

HENRY L. TAYLOR, GAVAN LINTERN, JEFFERSON M. KOONCE, ROBERT H. KAISER, and GREGORY A. MORRISON (Illinois, University, Urbana) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 11 p. refs
(Contract DTFA01-90-C-00045)
(SAE PAPER 912099) Copyright

Beginning flight students were taught landings in a flight simulator with a visual landing display to examine the effects of scene detail, visual augmented guidance, and the number of landing training trials. Transfer as assessed in a criterion simulator configuration showed advantages for larger numbers of training trials, visual augmented guidance, and moderate scene detail. Transfer of training to the aircraft showed advantages for low-scene detail over moderate-scene detail for the number of landing training sessions. Subjects who received equal simulator time practicing an instrument pattern (control group) performed better than the moderate-scene detail group on student assisted landings and number of landing training sessions. Author

A92-39957

COMPUTER-BASED PROCEDURAL TRAINING

TOM CORDELL (United Airlines, Chicago, IL) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 8 p. refs
(SAE PAPER 912100) Copyright

The training effectiveness of a procedures trainer based on full-scale computer-drawn artwork with a touch point for each switch, light, gauge, or control has been studied. Flight-naïve college students participated in the experiments. Data obtained show that imposition of rigid order on procedural tasks aids learning, and practice on the procedures trainer helps to impose this order and procedural transfer to the aircraft. O.G.

A92-39979

TRAINING FOR ADVANCED TECHNOLOGY AIRCRAFT - A PILOT'S PERSPECTIVE

HARRY W. ORLADY SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Sept. 23-26, 1991. 10 p.
(SAE PAPER 912140) Copyright

Changing needs in pilot training for Advanced Technology (ADVTECH) aircraft are examined. The importance of line-oriented flight training and crew resource management in that training is addressed. The role of training centers, provided for under the FAA's Advanced Qualification Program, are discussed. C.D.

A92-40751

USE OF TRAINING SIMULATORS FOR DIAGNOSING FUNCTIONAL DISORDERS AND FOR RESTORATION OF PILOTS' WORK CAPACITY [ISPOL'ZOVANIE TRENAZHEROV DLIA DIAGNOSTIKI FUNKTSIONAL'NYKH RASSTROISTV I VOSSTANOVLENIYA PROFESSIONAL'NOI RABOTOSPOSObNOSTI]

V. A. BODROV (Rossiiskaia Akademiia Nauk, Institut Psikholgii,

Moscow, Russia) Fiziologiya Cheloveka (ISSN 0131-1646), vol. 18, no. 1, Jan.-Feb. 1992, p. 33-41. In Russian. refs
Copyright

The expediency of using training simulators for diagnosing in pilots a number of functional disorders of the nervous and cardiovascular systems at their prenosologic stages (i.e., preliminary stages devoid of definite clinical symptoms) was investigated (together with the feasibility of using simulators for rehabilitation purposes) using the results of physiological measurements and psychoanalyses. The paper describes the occupational load tests recommended for diagnostic purposes and a program of rehabilitation exercises. Results of using these regimens are presented. I.S.

A92-40752

THE CHARACTERISTICS OF ADAPTATION OF OPERATORS TO SLEEP DEPRIVATION - THE ANALYSIS OF THE DYNAMICS OF THE BRAIN BIOPOTENTIALS AND OF BEHAVIORAL PARAMETERS [OSOBENNOSTI ADAPTATSII OPERATOROV K ASOMNII - ANALIZ DINAMIKI BIOPOTENTIALOV MOZGA I POVEDENCHESKIKH POKAZATELEI]

L. G. DIKAIYA, S. A. SHAPKIN, and A. N. GUSEV (Rossiiskaia Akademiia Nauk, Institut Psikholgii, Moscow, Russia) Fiziologiya Cheloveka (ISSN 0131-1646), vol. 18, no. 1, Jan.-Feb. 1992, p. 42-50. In Russian. refs
Copyright

Results are presented of an experimental study on the adaptability of human operators to a regimen of continuous 2-3-day-long activity without sleep. The experimental observations included measurements of changes in the efficiency of detecting a sound signal against a background of continuous noise, in the characteristics of the EEG spectrum, and in evoked potentials. Results identified the mechanism of the 'spotty memory' phenomenon, when the efficiency of signal recognition falls abruptly forming a gap in the detection signals, due to the destruction of the interaction between the activating, cognitive, and regulatory mechanisms of the sensory process. I.S.

N92-25372# National Space Development Agency, Tokyo (Japan). Space Station Program Dept.

PAYLOAD CREW TRAINING IN FUWATTO 1992 (FIRST MATERIAL PROCESSING TEST) PROJECT

MAMORU MOURI and SHIGEKI KAMIGAICHI In its Preprints of NASDA's 6th Technical Symposium p 1-22 5 Jun. 1991 In JAPANESE; ENGLISH summary
Avail: NTIS HC/MF A06

The plan and the status of FUWATTO'92 payload crew training for Japanese payload specialist and NASA mission specialist is reported. NASDA (National Space Development Agency of Japan) is preparing for the FUWATTO'92, FMPT (First Material Processing Test) planned in September, 1992 in which the space experiments will be conducted on the Space Shuttle and Spacelab. Dr. Mamoru Mouri, Japanese payload specialist, will operate the space experiments on board. Author (NASDA)

N92-25732*# Georgia Inst. of Tech., Atlanta.

REQUIREMENTS FOR PSYCHOLOGICAL MODELS TO SUPPORT DESIGN: TOWARDS ECOLOGICAL TASK ANALYSIS

ALEX KIRLIK 1991 43 p
(Contract NAG2-656)

(NASA-CR-190334; NAS 1.26:190334) Avail: NTIS HC/MF A03

Cognitive engineering is largely concerned with creating environmental designs to support skillful and effective human activity. A set of necessary conditions are proposed for psychological models capable of supporting this enterprise. An analysis of the psychological nature of the design product is used to identify a set of constraints that models must meet if they can usefully guide design. It is concluded that cognitive engineering requires models with resources for describing the integrated human-environment system, and that these models must be capable of describing the activities underlying fluent and effective

interaction. These features are required in order to be able to predict the cognitive activity that will be required given various design concepts, and to design systems that promote the acquisition of fluent, skilled behavior. These necessary conditions suggest that an ecological approach can provide valuable resources for psychological modeling to support design. Relying heavily on concepts from Brunswik's and Gibson's ecological theories, ecological task analysis is proposed as a framework in which to predict the types of cognitive activity required to achieve productive behavior, and to suggest how interfaces can be manipulated to alleviate certain types of cognitive demands. The framework is described in terms, and illustrated with an example from the previous research on modeling skilled human-environment interaction. Author

N92-26023# Naval Postgraduate School, Monterey, CA.
FINITE MEMORY MODEL FOR HAPTIC RECOGNITION M.S.
Thesis

PHILIP G. BEIERL Dec. 1991 81 p
 (AD-A245342) Avail: NTIS HC/MF A05

This study attempts to model the process by which humans identify remote objects using a force reflecting telemanipulator in order to apply this understanding to future ROV designs employing the concept of telepresence. A theoretical model is proposed in which object identification is primarily independent upon feature identification and capacity to remember the sequence of features. A computer simulation of this model is constructed and used to produce theoretical object identification performance which can be compared to actual human performance. The capacity of short term memory of a sequence of features is also studied in a laboratory using a telemanipulator. GRA

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MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

A92-36535

THE DESIGN PRINCIPLES AND FUNCTIONING OF AN AUTOMATED INFORMATION SYSTEM FOR ESTIMATING THE PRESHIFT WORK CAPACITY OF OPERATORS [PRINTSIPIY SOZDANIYA I FUNKSIONIROVANIYA AVTOMATIZIROVANNOI INFORMATSIONNOI SISTEMY PREDSMENNOI OTSENKI RABOTOSPOSOBNOSTI OPERATOROV]

A. I. U. BUROV (VNI Tekhnicheskoi Estetiki, Kiev, Ukraine) Kibernetika i Vychislitel'naia Tekhnika (ISSN 0454-9910), no. 90, 1991, p. 29-33. In Russian. refs

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The parameters of operators' work capacity, obtained as a result of testing, are considered as output coordinates of a complex dynamic system, and the feasibility of using these indexes for estimating the system's organization and complexity is assessed. The obtained estimates are used to select the mathematical formula for describing man as a system, and, in particular, for selecting multiple regression models for predicting the work capacity of workers at electric power plants. An automated information system called SPORO for estimating the preshift work capacity of these operators is described. I.S.

A92-37170

FLUID-ELECTROLYTE LOSSES IN UNIFORMS DURING PROLONGED EXERCISE AT 30 C

LAWRENCE E. ARMSTRONG, PATRICIA C. SZLYK, JANE P. DE LUCA, INGRID V. SILS, and ROGER W. HUBBARD (U.S. Army, Research Institute of Environmental Medicine, Natick, MA; Connecticut, University, Storrs) Aviation, Space, and

Environmental Medicine (ISSN 0095-6562), vol. 63, no. 5, May 1992, p. 351-355. refs

Copyright

The effects of several uniform configurations on fluid and electrolyte losses in a hot environment (30 C) were investigated in healthy humans performing 6-hr-long intermittent treadmill exercise while wearing these uniforms. Three types of uniforms were tested: the temperate battle dress uniform (BDU), two variants (C and F) of full military oriented protective posture (MOPP IV), and MOPP IV without mask or hood (M). Measurements of fluid and electrolyte loss parameters showed that both C and F MOPP IV configurations resulted in significantly greater fluid losses and physiological strain than did BDU and M. The total losses of all electrolytes, on the other hand, showed no differences due to the type of uniform. I.S.

A92-38133* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.

CONTROL OF WATER AND NUTRIENTS USING A POROUS TUBE - A METHOD FOR GROWING PLANTS IN SPACE

THOMAS W. DRESCHER and JOHN C. SAGER (Bionetics Corp.; NASA, Kennedy Space Center, Cocoa Beach, FL) HortScience (ISSN 0018-5345), vol. 24, no. 6, Dec. 1989, p. 944-947. refs (Contract NAS10-10285)

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A plant nutrient delivery system that uses a microporous, hydrophilic tube was developed with potential application for crop production in the microgravity of space. The tube contains a nutrient solution and delivers it to the roots. Pumps attached to the tubing create a very small suction that holds the solution within the tube. This system was used to grow wheat for 107 d in a controlled environment at suctions of 0.40, 1.48, or 2.58 kPa. The water absorbed through the pores of the tube by baby diaper sections decreased as suction increased. Correspondingly, final plant biomass, seed number, and spikelet number also tended to decrease as suction increased. The reduced yield at higher suction suggests that the plants experienced water stress, although all suctions were below those typical of soils at field capacity. Author

A92-38138* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

NUTRITION IN SPACE - EVIDENCE FROM THE U.S. AND THE U.S.S.R

HELEN W. LANE (NASA, Johnson Space Center, Houston, TX) Nutrition Reviews (ISSN 0029-6643), vol. 50, no. 1, Jan. 1992, p. 3-6. refs

Copyright

Space flight exposes humans to a hostile, stressful environment as well as to the weightlessness associated with microgravity. The stresses of space travel affect nutritional balance, as evidenced by interrelated changes in body composition, energy utilization, and endocrine function. The limited data gathered thus far suggest that space flight incurs acute decreases in fluid mass and chronic, ongoing changes in muscle and bone mass. Concurrent with these changes is an increase in energy used per unit body mass. Other preliminary data suggest that bed rest and space flight may incur increased sensitivity to insulin. Further research is needed to determine the human energy and protein requirements for space, as well as a means of quantifying changes in body composition during extended-duration space flight. Author

A92-38156 National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

LIGNIFICATION IN YOUNG PLANT SEEDLINGS GROWN ON EARTH AND ABOARD THE SPACE SHUTTLE

JOE R. COWLES, R. LEMAY, G. JAHNS, W. H. SCHELD, and C. PETERSON (Houston, University, TX) IN: Plant cell wall polymers - Biogenesis and biodegradation. Washington, DC, American Chemical Society, 1989, p. 203-213. refs (Contract NSG-9042; NAS2-11165)

Copyright

The Space Shuttle era has provided an opportunity for

investigators to conduct experiments in a microgravity environment. Two Shuttle flights, STS-3 and STS-51F, each contained an experiment designed principally to determine whether young plant seedlings exposed to microgravity had reduced lignin content in comparison to seedlings grown at one gravity. Three different plant species, pine, oats, and mung beans, were exposed for eight days to the microgravity environment of the Shuttle. The lignin content of in-flight seedlings was less than the control seedlings in all seven sets of seedlings included in these two experiments. In five sets of seedlings, the reduction in lignin content in flight seedlings ranged from 6 to 24 percent and was statistically significant. In addition, the activity of two enzymes involved in lignin synthesis, phenylalanine ammonia lyase and peroxidase, were significantly reduced in pine seedlings. It was therefore concluded that microgravity, as perceived by young plant seedlings, results in reduced lignin synthesis. Author

A92-38161* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.

A PROTOTYPE CLOSED AQUACULTURE SYSTEM FOR CONTROLLED ECOLOGICAL LIFE SUPPORT APPLICATIONS

T. W. DRESCHER, C. F. BAUER, M. S. KOLLER (Bionetics Corp., Cocoa Beach, FL), and J. C. SAGER (NASA, Kennedy Space Center, Cocoa Beach, FL) Aquaculture Symposium, Cornell University, Ithaca, NY, Apr. 4-6, 1991, Paper. 10 p. refs (Contract NAS10-11624)

Copyright

Aquaculture has been proposed as a possible component of a life support system for extended duration space exploration. Atmospheric and hydrologic closure of an aquaculture system are necessary for this application and information on mass flows through such a system is important to integrating it as part of life support. A closed aquaculture system has been constructed and an extensive computer monitoring and control system and sampling protocol developed to provide this information. Preliminary tests indicate that the system has a negligible leak rate and can provide oxygen and carbon dioxide mass flow information. Author

A92-38299

SENSOR DATA DISPLAY FOR TELEROBOTIC SYSTEMS

MARGARET M. CLARKE and DAVOUD MANOUCHEHRI (Rockwell International Corp., Downey, CA) IN: Space Congress, 27th, Cocoa Beach, FL, Apr. 24-27, 1990, Proceedings. Cape Canaveral, FL, Canaveral Council of Technical Societies, 1990, p. 5-11 to 5-21. refs

Copyright

The problem of displaying telerobotic sensor information at operator workstations to enhance telepresence is examined. The paper addresses the challenges associated with displaying data from remote tasks and lists the requirements of operator-friendly data displays. The integration of sensors on a telerobotics device is then described along with the characteristics of the data display employed. A force-torque sensor is employed on a remote manipulator arm, and the Graphical Kernel System is used to display the force and torque data pictorially in one of four graphic formats. The data are presented as a bar chart, numerical values, vector arrows, and/or slave-wrist orientation descriptions. It is concluded that the operator should eventually be removed from the control loop by reducing operator reliance on sensory feedback to control tasks. Graphic formats that are more user-friendly such as video images and voice input can be employed to ease existing telerobotic tasks. C.C.S.

A92-38491#

THE SPACE ROBOT TECHNOLOGY EXPERIMENT ROTEX ON SPACELAB-D2

G. HIRZINGER and K. LANDZETTEL (DLR, Oberpfaffenhofen, Federal Republic of Germany) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 15 p. refs

(AIAA PAPER 92-1294) Copyright

The telerobotic concepts as presently developed for a space robot technology experiment ROTEX to fly with the next spacelab

mission D2 in 1993 are outlined; the robot is supposed to work in an autonomous mode, teleoperated by astronauts, and teleoperated from ground. One of its key hardware features is a recently developed multisensory gripper and a high-weight robot concept with new joint drives and grid-structure composite arms for the astronaut training on ground. Sensory feedback schemes and man-machine interface concepts using a 6 DOF control ball and stereo imaging is explained. Sensory simulation on ground using advanced stereo graphics is supposed to predict the sensor based path refinement on board, while realtime fusion of stereo images and laserscan information helps to predict the motion of floating objects to be grasped. Author

A92-38501*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

DEVELOPMENT OF TASK NETWORK MODELS OF HUMAN PERFORMANCE IN MICROGRAVITY

MANUEL F. DIAZ (Lockheed Engineering and Sciences Co., Houston, TX) and SUSAN ADAM (NASA, Johnson Space Center, Houston, TX) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 8 p. refs (AIAA PAPER 92-1311)

This paper discusses the utility of task-network modeling for quantifying human performance variability in microgravity. The data are gathered for: (1) improving current methodologies for assessing human performance and workload in the operational space environment; (2) developing tools for assessing alternative system designs; and (3) developing an integrated set of methodologies for the evaluation of performance degradation during extended duration spaceflight. The evaluation entailed an analysis of the Remote Manipulator System payload-grapple task performed on many shuttle missions. Task-network modeling can be used as a tool for assessing and enhancing human performance in man-machine systems, particularly for modeling long-duration manned spaceflight. Task-network modeling can be directed toward improving system efficiency by increasing the understanding of basic capabilities of the human component in the system and the factors that influence these capabilities. Author

A92-38502*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

A VISUAL DISPLAY AID FOR PLANNING ROVER TRAVERSALS

HERBERT F. BERNARD and STEPHEN R. ELLIS (NASA, Ames Research Center, Moffett Field, CA) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 12 p. refs

(AIAA PAPER 92-1313) Copyright

An interactive graphical planning system has been developed, which allows a human operator to design and check traversals (cross-country paths) for a planetary rover vehicle. The display provides the operator with necessary information about the terrain and indicates violations of operational or dynamic constraints on the rover. The operator can select different kinds of two-dimensional maps as well as a perspective view of the rover environment to plan the traversals. An experiment has been carried out to determine the ability of the operator to estimate the rover attitude in a large variety of situations. It turned out that the estimation error is highly dependent on the rover attitude itself. This result can be used to determine a vertical scale for the perspective representation of the terrain which avoids an underestimation of dangerous rover attitudes. Author

A92-38503#

NEUTRAL BUOYANCY AND VIRTUAL ENVIRONMENT EXPERIMENTS IN TELEOPERATED AND AUTONOMOUS CONTROL OF SPACE ROBOTS

HAROLD L. ALEXANDER (MIT, Cambridge, MA) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 7 p. refs

(AIAA PAPER 92-1316) Copyright

Extravehicular activity is becoming a powerful limiting factor in the exploration and exploitation of space. Free-flying robots can

be controlled from the ground, from space, and automatically in order to perform many of the tasks now envisioned for astronauts. This will free astronauts for their primary scientific and observational functions, and substantially reduce the hazards and cost associated with space activities. This paper reviews the technologies necessary for developing effective space robots, as well as efforts in this direction at MIT's Laboratory for Space Teleoperation and Robotics. Author

A92-38579# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

RESULTS OF TELEROBOTIC HAND CONTROLLER STUDY USING FORCE INFORMATION AND RATE CONTROL

KELLI F. WILLSHIRE, F. W. HARRISON, EDWARD F. HOGGE, ROBERT L. WILLIAMS, and DONALD SOLOWAY (NASA, Langley Research Center, Hampton, VA) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 11 p. Research supported by Honeywell, Inc., McDonnell Douglas Space Systems Co., and NASA. refs
(AIAA PAPER 92-1451) Copyright

To increase quantified information about the effectiveness and subjective workload of force information relayed through manipulator input control devices, a space related task was performed by eight subjects with kinesthetic force feedback and/or local force accommodation through three different input control devices (i.e., hand controllers) operating in rate control mode. Task completion time, manipulator work, and subjective responses were measured. Results indicated a difference among the hand controllers. For the Honeywell six degree-of-freedom hand controller, the overall task completion times were shortest, the amount of work exerted was the least, and was the most preferred by test subjects. Neither force accommodation with or without reflection resulted in shorter task completion times or reduced work although those conditions were better than no force information for some aspects. Comparisons of results from previous studies are discussed. Author

A92-38580*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

NATURAL TRANSITION FROM RATE TO FORCE CONTROL OF A MANIPULATOR

F. W. HARRISON, DON SOLOWAY, ROBERT L. WILLIAMS, and EDWARD F. HOGGE (NASA, Langley Research Center, Hampton, VA) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 11 p. refs
(AIAA PAPER 92-1452) Copyright

A method for teleoperator control which offers advantages over previous techniques is demonstrated. In the new method, a fundamental variable exchanged between the master and slave is the rate of change in position and force. An inherent capability of the control scheme is demonstrated for transition between control methods based on environmental constraints in a manner natural to the operator. Specifically, rate control of a manipulator makes the transition to force-force control when a force-reflecting hand controller is used with a local force accommodation algorithm running on the remote manipulator. The transition from rate to force occurs when contact is made with the environment. C.D.

A92-38581*# National Aeronautics and Space Administration, Washington, DC.

GRASP FORCE CONTROL IN TELEMANIPULATION

STEVEN F. WIKER and NEIL A. DUFFIE (Wisconsin, University, Madison) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 13 p. Research supported by University of Wisconsin. refs
(Contract NAGW-975)
(AIAA PAPER 92-1453) Copyright

This paper presents two experiments which focus upon the issue of grasp force control in telemanipulation. The first experiment examines the ability to control and stabilize master-controller grasp force during a 30-s compensatory tracking task under different levels of master controller digit mass, friction, and backlash. The second experiment explores the potential for substituting tactile

feedback in lieu of direct force-feedback to gage and control remote grasp force. Results show that subjects were better able to control force when mass and friction levels were increased. Even when perceptual gains between tactile and direct force feedback displays were matched, force reflection produced better grasp control. The lack of backlash effects and improvements in performance with direct force reflection in comparison to tactile feedback are attributable to reflexive short-loop adjustment of grasp tension afforded by the muscle's length-tension control system. The criterion of acceptable operator performance, dependent upon both the quality of the transmission of control commands and feedback, and the response of the remote device, is discussed. Author

A92-38622#

WORKSTATIONS FOR THE ON-ORBIT CREW IN SPACE STATION FREEDOM

GARY GERSHZOHN (McDonnell Douglas Space Systems Co., Huntington Beach, CA) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 6 p. refs
(AIAA PAPER 92-1522) Copyright

The operations of Space Station Freedom will be controlled from on-orbit workstations constituting the Station's nerve center; 'human engineering' flight crew integration (FCI) requirements are rendered especially important by the life- and mission-critical functions conducted by the crew at these locations over the 30-year service life of the Station. FCI design efforts must define workstation crew requirements regarding crew operations, displays and controls, overall configuration, and lighting. Workstation types encompass command/control, glass-enclosed 'cupolas' (for views of manipulators and EVAs), laboratory controllers, and crew health care sites. O.C.

A92-38623#

APPLIED CONCEPTS FOR COMMAND AND CONTROL HUMAN-COMPUTER INTERFACE FOR SPACE STATION

D. J. BENNETT, J. M. LOMAN, and S. A. WOLSTEIN (McDonnell Douglas Space Systems Co., Houston, TX) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 11 p. refs
(AIAA PAPER 92-1523) Copyright

Given the command and control architecture of Space Station Freedom (SSF) and the tailored nature of its Data Management System's (DMS) User Support Environment (USE) graphical user interface, constraints have been placed on the design and flexibility of the on-board displays. This paper will review the work to date to provide a useable and acceptable human-computer interface for command and control on board SSF. Discussion will focus on the development tools, the current station architecture and the constraints that those impart to the on-board displays. Current design efforts will be described in detail with emphasis on the effort to provide displays that are both feasible within the program and acceptable to industry human-computer interface standards. Author

A92-38666*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

CONTROL OF ROBOT DYNAMICS USING ACCELERATION CONTROL

G. L. WORKMAN, S. PRATERU, W. LI (Alabama, University, Huntsville), and ELAINE HINMAN (NASA, Marshall Space Flight Center, Huntsville, AL) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 11 p. Research supported by Alabama Industrial Development Training Institute. refs
(AIAA PAPER 92-1573) Copyright

Acceleration control of robotic devices can provide improvements to many space-based operations using flexible manipulators and to ground-based operations requiring better precision and efficiency than current industrial robots can provide. This paper reports on a preliminary study of acceleration measurement on robotic motion during parabolic flights on the NASA KC-135 and a parallel study of accelerations with and without

gravity arising from computer simulated motions using TREETOPS software. Author

A92-38667*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

TELEOPERATOR PERFORMANCE IN SIMULATED SOLAR MAXIMUM SATELLITE REPAIR

PAUL S. SCHENKER, HARI DAS, and ANTAL K. BEJCZY (JPL, Pasadena, CA) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 13 p. refs (AIAA PAPER 92-1574) Copyright

An investigation is conducted of the relative benefits of different teleoperator control modes in simulated space servicing. The simulation replicates part of the Solar Maximum EVA Satellite Repair (SMSR) mission of STS-13, in 1974. The formal experimental design and statistical analysis presented demonstrates that position control is superior for small workspace volume management. Quantitative studies demonstrate significant benefits of shared Cartesian control modes for contact tasks; good performance will require the systematic analysis and synthesis of man-machine systems. O.C.

A92-38668#

TELEROBOTIC INTERACTIONS IN AN EVA WORKSITE

D. AKIN, R. HOWARD, and E. SORENSON (Maryland, University, College Park) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 10 p. (AIAA PAPER 92-1575) Copyright

The Space Systems Laboratory has performed a number of neutral buoyancy tests to determine the usefulness of teleoperators in space operations. In January of 1989 a series of tests were performed at the NASA Marshall Space Flight Center in Huntsville, Alabama. The teleoperators were tested both independently and as EVA assistants for a variety of tasks involving structural assembly and HST servicing. Although the teleoperators were capable of performing some of the tasks alone, further development in high force and torque output as well as improved positioning accuracy would be necessary for the robots to replace an EVA subject. The teleoperators proved more successful as EVA assistants, allowing the test subjects to concentrate on the more difficult tasks involving large forces or torques or high dexterity. Author

A92-38669*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

REDUNDANT ARM CONTROL IN A SUPERVISORY AND SHARED CONTROL SYSTEM

PAUL G. BACKES and MARK K. LONG (JPL, Pasadena, CA) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 8 p. refs (AIAA PAPER 92-1578) Copyright

The Extended Task Space Control approach to robotic operations based on manipulator behaviors derived from task requirements is described. No differentiation between redundant and non-redundant robots is made at the task level. The manipulation task behaviors are combined into a single set of motion commands. The manipulator kinematics are used subsequently in mapping motion commands into actuator commands. Extended Task Space Control is applied to a Robotics Research K-1207 seven degree-of-freedom manipulator in a supervisory telerobot system as an example. Author

A92-38685#

ECLSS MODELING OF EXERCISING CREWMEMBERS ABOARD SPACE STATION FREEDOM

DOUGLAS J. BUTLER (Eagle Technical Services, Inc., Houston, TX) and MO SAIIDI (McDonnell Douglas Space Systems Co., Houston, TX) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 10 p. refs (AIAA PAPER 92-1604) Copyright

Through the use of a two-node thermal man model, the environmental impacts and resources necessary to support an exercising crewmember aboard SSF are examined. The increase

in humidity, carbon dioxide production, oxygen consumption, and metabolic latent and sensible heat loads which occur from exercise in an enclosed environment are simulated within the SSF ECLSS performance envelope. In an effort to benchmark model performance, model generated output has been compared with data recorded during the Preliminary ECF Ventilation Test. Results of this study have been used to support development of a preliminary ventilation scheme for the ECF of the Crew Health Care System (CHCS) and will be used to derive daily metabolic requirements for exercising crewmembers aboard SSF. Author

A92-38686#

MICROBIAL SCREENING OF WATER SUPPLIES FOR SPACEFLIGHT MISSIONS

GORDON SNYDER, JARROD D. O'LEARY, BRUCE MOUNT, and BARRY H. PYLE (Perkin-Elmer Corp., Pomona, CA) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 6 p. refs

(AIAA PAPER 92-1605) Copyright

The need to monitor water supplies for microbial contamination depends upon the final use requirements of the water. These requirements can be different for injectable, laboratory, hygiene, and potable water supplies. The design of a screening technique capable of automation and use in microgravity is presented. Culture chambers are continuously monitored for changes resulting from metabolic by-products. The times to detection can be correlated with initial CFU concentrations. The computer monitors the growth of various microorganisms in different media and various culture conditions. These data illustrate graphically and statistically changes or differences in resultant growth responses. The effects of iodine or other biocides on viability of microorganisms, recovery time, and growth rate changes can be determined. Author

A92-38687*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, AL.

CHEMICAL AND MICROBIOLOGICAL EXPERIMENTATION FOR DEVELOPMENT OF ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEMS

G. A. WHITMAN, M. E. WILSON, H. E. COLE (Boeing Defense and Space Group, Huntsville, AL), and M. TRAWEEK (NASA, Marshall Space Flight Center, Huntsville, AL) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 10 p. refs

(AIAA PAPER 92-1606) Copyright

Microbiological techniques are under study with a view to the identification of viable microorganisms in liquid cultures, improve the identification of stressed organisms, and determine the biocidal activity of iodine and other chemicals on isolates from recycled water. A quality-assurance program has been implemented to validate data employed in making decisions concerning engineering and human health and safety. Analytical laboratory refinements will strongly aid the development of environmental control and life-support systems. O.C.

A92-38688#

90-DAY CABIN RUN - LESSONS LEARNED AND RECOMMENDATIONS FOR FUTURE MANNED CLOSED ENVIRONMENT TESTS

J. H. COLEGROVE, A. M. GARDNER, and V. L. MILBURN (McDonnell Douglas Space Systems Co., Huntington Beach, CA) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 11 p. refs (AIAA PAPER 92-1608) Copyright

The purpose of this paper is to revisit and elucidate relevant data from a series of chamber tests employing closed-loop life support systems for an isolated four-person crew that were conducted at McDonnell Douglas Astronautics Company (MDAC) from 1964 to 1970. The test series culminated in a 90-day test in the Space Station Simulator (SSS). These tests, thought to pioneer human-rated chamber testing and related crew selection, management, and operational techniques, can provide significant information to support the expected revival of this test regimen under the Space Exploration Initiative. The results from the 90-day

test will be examined; share, via the references, some of the available body of reports and data; and suggest pitfalls to avoid and make recommendations for facility design, test organization, crew and staff selection, and operations based upon these experiences. Author

A92-38705* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

CREW CONSIDERATIONS IN THE DESIGN FOR SPACE STATION FREEDOM MODULES ON-ORBIT MAINTENANCE

JACK W. STOKES and KATHERINE A. WILLIAMS (NASA, Marshall Space Flight Center, Huntsville, AL) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 6 p. refs

(AIAA PAPER 92-1636) Copyright

The paper presents an approach to the maintenance process currently planned for the Space Station Freedom modules. In particular, it describes the planned crew interfaces with maintenance items, and the anticipated implications for the crew in performing the interior and exterior maintenance of modules developed by U.S., ESA, and NASDA. Special consideration is given to the maintenance requirements, allocations, and approach; the maintenance design; the Maintenance Workstation; the robotic mechanisms; and the development of maintenance techniques. I.S.

A92-38735* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

DUAL-ARM SUPERVISORY AND SHARED CONTROL SPACE SERVICING TASK EXPERIMENTS

PAUL G. BACKES (JPL, Pasadena, CA) AIAA, Space Programs and Technologies Conference, Huntsville, AL, Mar. 24-27, 1992. 18 p. refs

(AIAA PAPER 92-1677) Copyright

A dual-arm task execution primitive has been implemented for cooperative dual-arm telerobotic task execution utilizing multiple sensors concurrently. The primitive has been integrated into a telerobot task execution system and can be called by a task planning system for execution of tasks requiring dual-arm sensor based motion, e.g., force control, teleoperation, and shared control. The primitive has a large input parameter set which is used to specify the desired behavior of the motion. Move-squeeze decomposition is utilized to decompose forces sensed at the wrists of the two manipulators into forces in the move subspace, which cause system motion, and forces in the squeeze subspaces, which cause internal forces. The move and squeeze forces are then separately controlled. Several space servicing tasks utilizing the cooperative dual-arm control capability are described, and experimental results from the tasks are given. The supervisory and shared control tasks include capture of a rotating satellite, orbital replacement unit changeout, fluid coupler seating and locking, and contour following. Author

A92-39196* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

DEVELOPMENT OF EXERCISE DEVICES TO MINIMIZE MUSCULOSKELETAL AND CARDIOVASCULAR DECONDITIONING IN MICROGRAVITY

DOUGLAS F. SCHWANDT, ROBERT T. WHALEN, DONALD E. WATENPAUGH, SCOTT E. PARAZYNSKI, and ALAN R. HARGENS (NASA, Ames Research Center, Moffett Field, CA) (International Union of Physiological Sciences Commission on Gravitational Physiology, Annual Meeting, 12th, Leningrad, USSR, Oct. 14-18, 1990, Proceedings. A92-39126 16-51) Physiologist, Supplement (ISSN 0031-9376), vol. 34, no. 1, Feb. 1991, p. S-189, S-190. refs

The paper describes three exercise devices, developed at the NASA-Ames Research Center, for maintaining musculoskeletal and cardiovascular fitness in astronauts during extended space flights. These devices represent the following exercise concepts: (1) exercise against LBNP, (2) instrumented dynamic interlimb resistance, and (3) multiple resistive exercise. The three devices complement each other to provide the aerobic and strength training

exercises for different situations. All three devices permit eccentric, concentric, and isometric contractions for a variety of exercises. I.S.

A92-39306

FLIGHT SAFETY - HUMAN FACTORS, THE KEY TO PROGRESS

FRANK H. HAWKINS IN: Safety at sea and in the air - Taking stock together; Proceedings of the Conference, London, England, Nov. 13-15, 1990. London, Royal Aeronautical Society, 1990, p. 13.1-13.8. refs

Copyright

It is noted that although aviation is basically a technological activity, present safety levels can be enhanced most effectively through improved attention to the human component in the system. This attention must be applied by increasing an understanding of the characteristics of this human element, its capabilities and limitations at all levels in the industry, including management. Attention is given to the working interrelationship in the cockpit between hardware, software and 'liveware' (the human component). R.E.P.

A92-39504* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

HUMAN FACTORS ISSUES FOR INTERSTELLAR SPACECRAFT

MARC M. COHEN and ADAM R. BRODY (NASA, Ames Research Center; Sterling Software, Inc., Moffett Field, CA) IN: Space Congress, 28th, Cocoa Beach, FL, Apr. 23-26, 1991, Proceedings. Cape Canaveral, FL, Canaveral Council of Technical Societies, 1991, p. 1-19 to 1-29. refs

Copyright

Developments in research on space human factors are reviewed in the context of a self-sustaining interstellar spacecraft based on the notion of traveling space settlements. Assumptions about interstellar travel are set forth addressing costs, mission durations, and the need for multigenerational space colonies. The model of human motivation by Maslow (1970) is examined and directly related to the design of space habitat architecture. Human-factors technology issues encompass the human-machine interface, crew selection and training, and the development of spaceship infrastructure during transtellar flight. A scenario for feasible interstellar travel is based on a speed of 0.5c, a timeframe of about 100 yr, and an expandable multigenerational crew of about 100 members. Crew training is identified as a critical human-factors issue requiring the development of perceptual and cognitive aids such as expert systems and virtual reality. C.C.S.

A92-39509

AUTONOMOUS ROBOTIC SYSTEMS FOR SEI TASKS

DAVOUD MANOUCHEHRI, C. M. WU, MARGARET M. CLARKE, and A. J. MAUCERI (Rockwell International Corp., Downey, CA) IN: Space Congress, 28th, Cocoa Beach, FL, Apr. 23-26, 1991, Proceedings. Cape Canaveral, FL, Canaveral Council of Technical Societies, 1991, p. 2-19 to 2-26. refs

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The development of robotic sensors and displays for the Space Exploration Initiative (SEI) is described in which autonomous designs with closed control loops are incorporated. The designs are described in terms of the problem of the time delays inherent in space travel which give rise to system instability. A general control algorithm is developed for telerobotic control-system architectures that is based on a six-level hierarchy, and the implementation of the algorithm is shown schematically. The architecture is called Nasrem and its implementation can facilitate the transfer and adaptation of intelligence/autonomy from one machine to another and provide the hooks for the high-level executive to control several machines in a complex operation. The architecture is shown to have the potential for developing autonomous robotic systems so that the human operator is removed from the lower control levels required for SEI missions such as running a lunar base. C.C.S.

A92-39539* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

UTILIZATION OF COMMON PRESSURIZED MODULES ON THE SPACE STATION FREEDOM

DANIEL D. MAZANEK, MICHAEL L. HECK (Analytical Mechanics Associates, Inc.; NASA, Langley Research Center, Hampton, VA), and MARSTON J. GOULD (NASA, Langley Research Center, Hampton, VA) IN: Space Congress, 28th, Cocoa Beach, FL, Apr. 23-26, 1991, Proceedings. Cape Canaveral, FL, Canaveral Council of Technical Societies, 1991, p. 8-67 to 8-76. Previously announced in STAR as N91-20189.

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During the preliminary design review of Space Station Freedom elements and subsystems, it was shown that reductions of cost, weight, and on-orbit integration and verification would be necessary in order to meet program constraints, particularly nominal Orbiter payload launch capability. At that time, the Baseline station consisted of four resource nodes and two 44 ft modules. In this study, the viability of a common module which maintains crew and payload accommodation is assessed. The size, transportation, and orientation of modules and the accommodation of system racks and user experiments are considered and compared to baseline. Based on available weight estimates, a module pattern consisting of six 28 ft common elements with three radial and two end ports is shown to be nearly optimal. Advantageous characteristics include a reduction in assembly flights, dual egress from all elements, logical functional allocation, no adverse impacts to international partners, favorable airlock, cupola, ACRV (Assured Crew Return Vehicle), and logistics module accommodation, and desirable flight attitude and control characteristics. Author

A92-39540

A ROBOT BASED CONCEPT FOR AUTOMATION AND SERVICING OF SCIENTIFIC PAYLOADS ABOARD ORBITING LABORATORIES

J. FLEMMIG and P. PUTZ (Dornier GmbH, Friedrichshafen, Federal Republic of Germany) IN: Space Congress, 28th, Cocoa Beach, FL, Apr. 23-26, 1991, Proceedings. Cape Canaveral, FL, Canaveral Council of Technical Societies, 1991, p. 8-77 to 8-85. refs

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A robotic system called the Equipment Manipulation and Transportation System (EMTS) is described in terms of its use for scientific-payload facility handling and logistics functions. Proposed applications of the EMTS are listed including use in the free-flying phase of Columbus laboratory, servicing the Columbus Free Flyer, and implementation in the Columbus Attached Pressurized Module. The performance and budgets for the EMTS are listed, and the mechanical architecture is described including elements such as the mobile base assembly, the arm assemblies, the arm-control unit and the robot-camera unit. An automation and robotics testbed for the Columbus program is outlined that is designed to validate the robot concepts by remotely controlling the manipulation of four racks with scientific payloads. The EMTS can be used to support manned payload-operations scenarios for the Columbus Free Flyer as well as the Attached Laboratory. C.C.S.

A92-39580* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

SPACE SUITS AND LIFE SUPPORT SYSTEMS FOR THE EXPLORATION OF MARS

LAWRENCE H. KUZNETZ (NASA, Ames Research Center, Moffett Field, CA) and OWEN GWYNNE (SETI Institute; NASA, Ames Research Center, Moffett Field, CA) British Interplanetary Society, Journal (ISSN 0007-094X), vol. 45, no. 5, May 1992, p. 215-224. refs

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The requirements and technologies needed for space suits to be used for the manned exploration of Mars are examined. Alternative concepts are proposed for both the space suit and the portable life support system (collectively called the Extravehicular Mobility Unit, or EMU) needed for Mars exploration. EMU system requirements are outlined. It is pointed out that the most fundamental difference between a Mars EMU and those

that preceded it is that the design of a Mars EMU must be driven by science and permanent habitability requirements, while all prior EMU designs have been driven by engineering requirements. The EMU weight issues are discussed, and the system mass and mobility concerns are addressed, along with the backpack-to-body-weight ratio. The challenges of thermal and cosmic radiation protection, micrometeorite protection, and EMU system and crew heat rejection are dealt with briefly, as well as the physiological issues of pressure regulation and bacterial or contaminant isolation. A mathematical model is then presented for evaluation of candidate EMU designs and for concept optimization and selection. Lead technology issues are also discussed. S.A.V.

A92-39749* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

A KINEMATIC ANALYSIS OF THE MODIFIED FLIGHT TELEROBOTIC SERVICER MANIPULATOR SYSTEM

CARL CRANE (Florida, University, Gainesville), TIM CARNAHAN (NASA, Goddard Space Flight Center, Greenbelt, MD), and JOSEPH DUFFY (Florida, University, Gainesville) Journal of Robotic Systems (ISSN 0741-2223), vol. 9, no. 4, June 1992, p. 461-480. refs

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A reverse kinematic analysis is presented of a six-DOF subchain of a modified seven-DOF flight telerobotic servicer manipulator system. The six-DOF subchain is designated as a TR-RT chain, which describes the sequence of manipulator joints beginning with the first grounded hook joint (universal joint) T, where the sequence R-R designates a pair of revolute joints with parallel axes. At the outset, it had been thought that the reverse kinematic analysis would be similar to a TTT manipulator previously analyzed, in which the third and fourth joints intersected at a finite point. However, this is shown not to be the case, and a 16th-degree tan-half-angle polynomial is derived for the TR-RT manipulator. S.A.V.

A92-40369* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

FORCE-REFLECTION AND SHARED COMPLIANT CONTROL IN OPERATING TELEMNIPULATORS WITH TIME DELAY

WON S. KIM (JPL, Pasadena, CA), BLAKE HANNAFORD (Washington, University, Seattle), and ANTAL K. BEJCZY (JPL, Pasadena, CA) IEEE Transactions on Robotics and Automation (ISSN 1042-296X), vol. 8, no. 2, April 1992, p. 176-185. refs

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The performance of an advanced telemanipulation system in the presence of a wide range of time delays between a master control station and a slave robot is quantified. The contemplated applications include multiple satellite links to LEO, geosynchronous operation, spacecraft local area networks, and general-purpose computer-based short-distance designs. The results of high-precision peg-in-hole tasks performed by six test operators indicate that task performance decreased linearly with introduced time delays for both kinesthetic force feedback (KFF) and shared compliant control (SCC). The rate of this decrease was substantially improved with SCC compared to KFF. Task performance at delays above 1 s was not possible using KFF. SCC enabled task performance for such delays, which are realistic values for ground-controlled remote manipulation of telerobots in space. C.D.

A92-40438

PROBLEMS EXPERIENCED BY MAN WHEN CONSTRUCTING GIANT STRUCTURES IN SPACE

C. A. TIMSIT (Medispace, Paris, France) IN: SPS 91 - Power from space; Proceedings of the 2nd International Symposium, Gif-sur-Yvette, France, Aug. 27-30, 1991. Paris, Societe des Electriciens et des Electroniciens and Societe des Ingenieurs et Scientifiques de France, 1991, p. 307-314. refs

Challenges that will be faced by astronauts during construction and servicing of giant structures in space are discussed. The role

of the space suit in coping with these challenges is addressed. The possible use of robots as a substitute for humans in some activities is considered. C.D.

A92-40942

LIVING AND WORKING IN SPACE - HUMAN BEHAVIOR, CULTURE AND ORGANIZATION

PHILIP R. HARRIS (Harris International, Ltd., La Jolla; Netrologic, Inc., San Diego, CA) Chichester, England/Englewood Cliffs, NJ, Ellis Horwood/Prentice Hall, 1992, 339 p. refs (ISBN 0-13-401050-7) Copyright

The behavioral science aspects of living and working in space are examined. The importance of a space ethos and synergy to extraterrestrial expansion is emphasized, and the broader human dimensions of space exploration and development beyond scientific and engineering considerations are addressed. The emergence of a unique space culture in the orbital environment is examined, taking into consideration the anthropological, sociological, psychological, and living systems aspects. The impact of organizational culture on space agencies and the aerospace industry is discussed, as is the influence of space technology and habitation on earth's population and cultures. A strategy for a space personnel deployment system is presented, and NASA innovations in space management are reviewed. The challenges created by the industrialization of space are addressed, and space habitation plans from NASA and ESA are reviewed along with the SEI and its implications. C.D.

N92-24293# California Univ., Berkeley. Lawrence Berkeley Lab.

AIR EXCHANGE EFFECTIVENESS OF CONVENTIONAL AND TASK VENTILATION FOR OFFICES

W. J. FISK, D. FAULKNER, and R. J. PRILL Dec. 1991 11 p Presented at the IAQ 1991: Healthy Buildings, Washington, DC, 4-8 Sep. 1991

(Contract DE-AC03-76SF-00098)

(DE92-008291; LBL-31652; CONF-910979-1) Avail: NTIS HC/MF A03

Air quality and comfort complaints within large buildings are often attributed to air distribution problems. We define three air exchange effectiveness parameters related to air distribution. The first two indicate the indoor air flow pattern (i.e., the extent of short circuiting, mixing, or displacement flow) for an entire building or region. The third parameter is most useful for assessments of the spatial variability of ventilation. We also define the air diffusion effectiveness which indicates the air flow pattern within specific rooms or sections of buildings. The results of measurements of these parameters in U.S. office buildings by the authors and other researchers are reviewed. Almost all measurements indicate very limited short circuiting or displacement flow between locations of air supply and removal. However, a moderate degree of short circuiting is evident from a few measurements in rooms with heated supply air. The results of laboratory-based measurements by the authors are consistent with the field data. Our measurements in office buildings do indicate that ventilation rates can vary substantially between indoor locations, probably due to variation in air supply rates between locations rather than variation in the indoor air flow patterns. One possible method of improving air distribution is to employ task ventilation with air supplied closer to the occupant's breathing zone. We have evaluated two task ventilation systems in a laboratory setting. During most operating conditions, these systems did not provide a region of substantially increased ventilation where occupants breathe. However, both systems are capable of providing substantially enhanced ventilation at the breathing zone under some operating conditions. Therefore, task ventilation is a potential option for using ventilation air more effectively. DOE

N92-24793# Ohio State Univ., Columbus. Dept. of Aeronautical and Astronautical Engineering.

PROJECT WISH: THE EMERALD CITY, PHASE 2

Jun. 1991 112 p

(Contract NASW-4435)

(NASA-CR-190011; NAS 1.26:190011) Avail: NTIS HC/MF A06 CSCL 06K

The purpose of the Permanently Manned Autonomous Space Oasis, designated Project WISH: The Emerald City, is to serve as permanent living quarters for space colonists. In addition, it will serve as a stopover for space missions and will be capable of restationing itself practically anywhere within the solar system to provide support for these missions. The station should be self-sufficient, with no specific dependence on any resources from Earth. The 1990 to 1991 design team continued work started by last year's class. Further studies were conducted in the areas of orbital mechanics, propulsion, attitude control, and human factors. Critical elements were identified in each of these areas, and guidelines were established for the design of the Emerald City. Using the knowledge gained from these studies, two particular missions of interest, a Saturn Envelope mission and an Earth to Mars mission, were examined. The size and mass estimates, along with the methodologies used in their determination, are considered to be the main accomplishments of phase 2. Author

N92-25161# Idaho Univ., Moscow.

EXERCISE/RECREATION FACILITY FOR A LUNAR OR MARS ANALOG Final Report

Jun. 1991 40 p

(Contract NASW-4435)

(NASA-CR-189993; NAS 1.26:189993) Avail: NTIS HC/MF A03

Discussed here is a project to design an exercise/recreation station for an earth based simulator of a lunar or Martian habitat. Specifically, researchers designed a stationary bicycle that will help people keep fit and prevent muscular atrophy while stationed in space. To help with motivation and provide an element of recreation during the workout, the bicycle is enhanced by a virtual reality system. The system will simulate various riding situations and the choice of mountain bike or road bike. The bike employs a magnetic brake that provides continuously changing tension to simulate actual riding conditions. This braking system will be interfaced directly with the virtual reality system. Also integrated into the virtual reality system will be a monitoring system that regulates heart rate, work rate, and other functions during the course of the session. Author

N92-25838# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).

EUROPEAN ECLSS TECHNOLOGY DEVELOPMENT RESULTS AND FURTHER ACTIVITIES

H. FUNKE, H. PREISS, S. KLINGELE, and G. TAN (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) In ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 p 103-111 Dec. 1991 Sponsored in part by ESA/ESTEC and DLR/BMFT

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In support of the Columbus IOC (Interorbit Communications) and EVA (Extravehicular Activity) ECLSS (Environment Control and Life Support System), a technology development program was performed on five items: regenerative CO₂ removal; trace gas contamination control and monitoring; low noise variable speed fan; and fan/pump/water separator (EVA). The contents and results of the concluding subsystem level tests for the Columbus items and the assembly test results for the EVA fan/pump/water separator and consecutive program extensions are described. The present status of the development of an O₂ reclamation system is pointed out. The scenario of ECLSS which will be necessary within the next decades are outlined. ESA

N92-25839# Hamilton Standard, Windsor Locks, CT.

ADVANCED REGENERATIVE LIFE SUPPORT FOR SPACE EXPLORATION

H. T. COUCH, J. W. AUMAN, JR., and T. C. FALVEY In ESA, 4th European Symposium on Space Environmental Control

Systems, Volume 1 p 113-120 Dec. 1991

Copyright Avail: NTIS HC/MF A24; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

Advanced regenerative Environmental Control and Life Support System (ECLSS) technology was identified by NASA as enabling for space exploration. Low Earth Orbit (LEO) mass savings of over 700,000 pounds (320,000 kg) per year are expected for a lunar outpost crew of eight as compared with ECLSS systems which are currently flying. ECLSS technologies which show promise for reducing LEO mass for long range exploration initiatives are explored. The role of In Situ Resource Utilization (ISRU) and a Closed Ecological Life Support System (CELSS) are discussed. Physical-chemical candidates for advanced technological development are recommended based on combined expendable, consumable and installed subsystem LEO mass savings for a number of advanced water processing and air revitalization approaches. These processes include: higher efficiency urine processing with or without pretreatment; a single water processor for potable and hygiene water; obtaining potable water and oxygen from the electrolysis system; chemical N₂ storage; and membrane gas separation processes. The benefits of these for increasing loop closure on N₂, O₂, and H₂O are discussed. ESA

N92-25840# Nauchno-Proizvodstvennoe Obединenie Nijichimmash, Moscow (USSR).

ENGINEERING PROBLEMS OF INTEGRATED REGENERATIVE LIFE-SUPPORT SYSTEMS

N. M. SAMSONOV, N. S. FARAFONOV, O. P. JAKIMENKO, E. I. GRIGOROV, V. N. KUBASOV, E. N. ZAITSEV, I. V. LAVROV, and B. A. ADAMOVICH (Institute of Biomedical Problems, Moscow, USSR) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 p 121-122 Dec. 1991

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Some problems of the development and the principles of construction of a complex of regenerative life support systems for space stations are dealt with. A structural schematic and the functions of a complex aboard the Soviet manned Space Station Mir are described. The possibility of water and oxygen artificial turnover being realized at zero gravity is shown and some related engineering problems are outlined. The use of simulated mathematical models and checking of serviceability of systems as components of Earth based medical/engineering complexes are considered. ESA

N92-25841# Alenia Spazio S.p.A., Turin (Italy).

A COMBINED CABIN/AVIONICS AIR LOOP DESIGN FOR THE SPACE STATION LOGISTIC MODULE

RENATO DAURIA and TIZIANO MALOSTI *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 p 123-127 Dec. 1991

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The Mini Pressurized Logistic Module (MPLM) is designed to transport cargo inside the Space Station Freedom. Results obtained from a preliminary design of the heat rejection and temperature control system are reported. Particular evidence is given to the combined cabin/avionics air loop design. This solution allows significant advantages to be gained in terms of mass, cost, control simplification, with respect to the more traditional approach which foresees separated cabin and avionics air loops. ESA

N92-25842# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

ESA STANDARDISATION PROCESS THROUGH THE EXAMPLE OF MANNED SPACECRAFT ATMOSPHERES

C. SOULEZ-LARIVIERE and J. C. LEPECHON (JCLP Hyperbarie, Paris, France) *In* its 4th European Symposium on Space Environmental Control Systems, Volume 1 p 129-131 Dec. 1991

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Principles guiding the elaboration of ESA standards (PSS series) in the fields of ECLS (Environment Control and Life Support) and human factors (objectives, ECLS specification tree, applicability, preparation, approval) are detailed. This standardization work is performed within the life support and habitability section of ESTEC. Through the example of manned spacecraft atmospheres, the way standards values are selected and how, as recommended practices, these standards should be used to prepare ECLS subsystem design requirements for supporting the European Manned space Infrastructure is illustrated. ESA

N92-25843# Nelson Space Services Ltd., London (England).

ESA PSS-03-406: LIFE SUPPORT AND HABITABILITY MANUAL

R. C. HUTTENBACH and R. A. BINOT (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 p 133-144 Dec. 1991

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Some of the features of a reference manual to be issued as part of a set of standards covering the subjects of environmental control, life support, habitability and human factors are described. The manual contains information on the general requirements of life support and habitability and the missions that will drive its associated technologies. It is formatted as a series of individual data sheets that can be updated regularly and which are designed to accommodate inputs from other organizations and individuals working in this subject area. It also includes details of promising experimental studies and theoretical concepts, as well as historical reviews, that will help to guide the selection of technologies and the design of new systems. Examples drawn from the manual, which highlight critical aspects of a systems approach to life support design are presented. Practical tradeoff methods that can be used to evaluate competing technologies and their combinations at subsystem and systems level are also described. ESA

N92-25862# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).

TRACE GAS CONTAMINATION MANAGEMENT IN THE COLUMBUS MTFF

H. ABELE and R. R. LAWSON (Bowman Ltd., Bristol, England) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 p 287-294 Dec. 1991

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The trace gas contamination management system for the Columbus Man Tended Free Flyer (MTFF) has to protect the crew from hazardous contamination of the module's atmosphere. This has to provide a set of hardware which is able to detect hazardous trace gases in the atmosphere and to control them below their Space Maximum Allowable Concentrations (SMAC). To achieve this goal, a system consisting of a monitoring assembly and a control assembly is proposed. A load model has to be established for the design of these assemblies. This model was determined by review of trace gas measurements and experiences of previous space missions coupled with the applicable requirements. ESA

N92-25863# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Space System and Project Dept.

AN INNOVATIVE TECHNOLOGY FOR DETECTING AND MONITORING TRACE-GAS CONTAMINATION OF THE COLUMBUS FREE FLYER ATMOSPHERE

R. STANYON and D. ZANOTTI *In* its 4th European Symposium on Space Environmental Control Systems, Volume 1 p 295-300 Dec. 1991

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The development of an original technology for detection and

recognition of trace gas contaminants in manned spacecraft atmospheres is described. Two different implementations of the same basic technology, both based on the principle of multiple sensors and pattern recognition, but utilizing different transducing methods and software concepts, are presented. Some of the experimental activities performed to demonstrate feasibility of this 'smart sensor' technology are described. In conclusion, the planning for future development (which includes a proposal for participation to the Columbus precursor flight program) is mentioned and potential free flyer applications identified. ESA

N92-25864# Bruker-Franzen Analytik G.m.b.H., Bremen (Germany, F.R.).

A GAS CHROMATOGRAPHIC SEPARATOR FOR COLUMBUS TRACE GAS CONTAMINATION MONITORING ASSEMBLY

J. FRANZEN, G. BAYKUT, H.-P. VETTERS, G. WEISS, and H. ABELE (Dornier System G.m.b.H., Friedrichshafen, Germany, F.R.) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 p 301-305 Dec. 1991

Copyright Avail: NTIS HC/MF A24; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

A development model gas chromatographic separator was designed and built for the trace gas contamination monitoring assembly of the Columbus Man Tended Free Flyers (MTFF's) environmental control and life support system. Atmospheric contaminants in the free flying laboratory will be analyzed by a gas chromatograph/mass spectrometer (GCMS). The gas chromatograph developed at this stage is compact, lightweight, low power consuming, and fast operating. It can easily be connected to the mass spectrometer, and its separation performance is very good for GCMS analysis. ESA

N92-25865# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

SELECTION OF AN OPTIMISED HIGH TEMPERATURE CATALYST FOR ATMOSPHERE TRACE CONTAMINANT CONTROL

J. WITT, D. DECHAMBURE, and K. AMMANN (Draegerwerk A.G., Luebeck, Germany, F.R.) *In* its 4th European Symposium on Space Environmental Control Systems, Volume 1 p 307-311 Dec. 1991

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Test were carried out in a life support unit with the goal to identify an optimized catalyst for the oxidation of methane and other hydrocarbons. Such a catalyst might be used in the life support system of the Columbus Free Flying Laboratory. Optimization parameters were: high conversion at low reaction temperature, lifetime, and resistance of catalyst poisoning and vibration. For the testprograms, eleven catalyst samples were obtained and subjected to performance screening, vibration, and poisoning tests. A monolithic catalyst performed best in all tests. ESA

N92-25866# Draegerwerk A.G., Luebeck (Germany, F.R.).
INVESTIGATION OF CATALYSTS FOR THE REMOVAL OF CARBON MONOXIDE AND HYDROGEN FROM AIR

K. AMMANN, H. HEYER, S. HAUPT, and A. EXNER (Deutsche Agentur fuer Raumfahrtangelegenheiten G.m.b.H., Bonn, Germany, F.R.) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 p 313-316 Dec. 1991

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A catalyst screening program was conducted to optimize the low temperature catalyst of the environmental control and life support system of space stations. The activity of the catalysts for the oxidation of carbon monoxide and hydrogen in air was measured in a laboratory setup in dependence on temperature, test gas composition, flow, pretreatment, and humidity. Eighteen noble metal catalysts of various manufacturers were tested. Humidity had a large influence on the long term stability of the

catalysts. Not all catalysts showed sufficient resistance to humid air. ESA

N92-25867# Draegerwerk A.G., Luebeck (Germany, F.R.).
BREADBOARDING OF THE MAIN CHARCOAL FILTER: A COMPONENT OF THE TRACE GAS CONTAMINATION CONTROL ASSEMBLY FOR THE MTF

H. HEYER, H. ABELE, K. AMMANN, and R. LAWSON (Erno Raumfahrttechnik G.m.b.H. Bremen, Germany, F.R.) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 p 317-322 Dec. 1991

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A breadboard model of a charcoal filter which is designed to remove a wide variety of organic vapors from the Space Station atmosphere by physical adsorption is described. The contaminants occurring in the Space Station's atmosphere are represented by 16 substances. Adsorption isotherms for the substances are determined in the range 0.9 to 0.001 of the saturated vapor. In a chamber, the contaminant amount generated during 180 days is simulated, and with the charcoal filter operating, equilibrium concentrations for the contaminants are determined. The influence of relative humidity on the equilibrium concentration is investigated in the range of 25 to 75 percent. Out of the 16 substances, only dichloromethane exceeds the spacecraft maximum allowable concentration at 75 percent relative humidity. ESA

N92-25868# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).

TRACE GAS MONITORING STRATEGIES FOR MANNED SPACE MISSIONS

S. KLINGELE and G. TAN (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 p 323-328 Dec. 1991

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Intermediate results of a study to identify trace gas monitoring needs, monitoring strategies, and suitable equipment for manned future space missions are reported. The identification of standardized space mission types is based on a comprehensive literature review. Each strategy is detailed by an example list of compounds, which are to be measured qualitatively and quantitatively. A selection of suitable monitoring equipment for each space mission type is foreseen, based on the list of compounds to be monitored within each strategy. A market screening of currently available measurement technology is performed, and an outlook on first preliminary results of the technology tradeoff is given. ESA

N92-25887# Oesterreichische Raumfahrt- und Systemtechnik, Vienna (Austria).

CARBON DIOXIDE REDUCTION SYSTEM AS PART OF AN AIR REVITALIZATION SYSTEM

K. SPERKER and G. TAN (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 p 469-472 Dec. 1991

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To meet the challenge of European long term manned missions on board a permanently orbiting space infrastructure, an Environmental Control and Life Support (ECLS) technology is to be developed. Limited to the spacecraft atmosphere management system, the ultimate goal is to close the airloop by processing the metabolically produced carbon dioxide, and reclaiming the oxygen from onboard resources to eliminate the costly resupply of oxygen from Earth. The best option today is a combination of three chemical-physical processes, namely a solid amine based carbon dioxide concentration system, a carbon dioxide reduction system

(Sabatier reactor), and a fixed bed alkaline electrolyzer. In order to develop the Sabatier reactor technology, a breadboard unit was designed and tested. ESA

N92-25888# Nauchno-Proizvodstvennoe Obedinenie Niichimmash, Moscow (USSR).

CARBON DIOXIDE REDUCTION ABOARD THE SPACE STATION

L. I. GAVRILOV, V. A. NAUMOV, A. I. RJABKIN (Nauchno-Proizvodstvennoe Obedinenie Energija, Kaliningrad, USSR), T. N. PAVLOVA, N. M. SAMSONOV, and N. S. FARAFONOV /In ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 p 473-475 Dec. 1991

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Classification of carbon dioxide reduction processes to be used in CO₂ processing systems is considered. The advantages and the problems of realization of the processes are considered. The results obtained in the development of a unit prototype based on the Sabatier process are discussed. ESA

N92-25889# Nauchno-Proizvodstvennoe Obedinenie Niichimmash, Moscow (USSR).

A SYSTEM FOR OXYGEN GENERATION FROM WATER ELECTROLYSIS ABOARD THE MANNED SPACE STATION MIR

J. E. BELAVENTSEV, L. I. GAVRILOV, A. S. GUZENBERG, N. S. GUSHIN, V. P. KOROLEV, A. G. PSHENICHNIKOV, A. M. RJABKIN (Academy of Sciences, USSR, Moscow), N. M. SAMSONOV, and N. S. FARAFONOV /In ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 p 477-479 Dec. 1991

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The problems arising from the development of systems for oxygen supply aboard the manned Mir Space Station are discussed. Electrolytic process realization, gas/electrolyte separation operational safety, and product oxygen quality are considered. The results of the Earth based system development and long term operation aboard the Space Station Mir are presented. The approaches to the improvement in the system design are contemplated. ESA

N92-25890# AiResearch Mfg. Co., Torrance, CA.
DEVELOPMENT OF A SABATIER CARBON DIOXIDE REDUCTION SYSTEM FOR SPACE APPLICATION

HAL J. STRUMPF and C. Y. CHIN /In ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 p 481-487 Dec. 1991

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A carbon dioxide reduction system is being developed for long duration manned space missions. The system incorporates a Sabatier methanation reactor, utilizing previously developed catalyst materials, and a hollow fiber membrane unit to separate the products of reaction. Heat produced by the exothermic Sabatier reaction is absorbed by an air stream, which also regulates the reactor temperature to maximize yield. This absorbed heat can be utilized elsewhere in the carbon dioxide management system to reduce power requirements. The Sabatier process combines carbon dioxide and hydrogen to form methane and water. In a manned space environment, the water is then either electrolyzed to form oxygen for breathing and hydrogen to drive the reaction, or recycles to the potable water system. A computer based performance model using finite elements was developed to evaluate reactor design and catalyst performance. Performance calculations for the preliminary reactor design indicate hydrogen conversion of over 99 percent in a carbon dioxide rich reaction. ESA

N92-25891# Nauchno-Proizvodstvennoe Obedinenie Niichimmash, Moscow (USSR).

AIR REGENERATION FROM MICROCONTAMINANTS ABOARD THE ORBITAL SPACE STATION

N. M. SAMSONOV, L. K. ABRAMOV, L. E. LITVINOV, V. I. MARGULIS, A. S. GUZENBERG, and A. M. RJABKIN (Nauchno-Proizvodstvennoe Obedinenie Energija, Kaliningrad, USSR) /In ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 p 489-491 Dec. 1991

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Major problems relating to the development of a system for atmospheric regeneration from harmful microcontaminants are dealt with: a classification of the composition of harmful contaminants, the formulation of the model composition of microcontaminants present in the atmosphere, the regeneration process flow diagram, the regeneration method, the accelerated lifetime test procedures. The results of Earth based complete tests of the system incorporated in the mockups of the module Kvant, the orbital Space Station Mir, a complex of the Space Station Mir/Kvant-2 as well as the development flight tests aboard an orbital complex of the Space Station Mir/Kvant/Kvant-2 are illustrated. The basic energy/mass characteristics of the system are described. ESA

N92-25892# CJB Developments Ltd., Portsmouth (England).

AIR PURIFICATION SYSTEMS FOR SUBMARINES AND THEIR RELEVANCE TO SPACECRAFT

R. A. J. DAMS, C. J. LEPPARD, and T. W. MARTIN /In ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 p 493-497 Dec. 1991

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A submarine's effectiveness is determined in part by its ability to remain submerged for extended periods. If this is to be achieved with a manned vessel, it is essential that the submarine is fitted with the means to maintain a safe and pleasant atmosphere for the crew to breathe. Nuclear powered submarines may remain isolated from the surface for 90 days or more and their atmosphere control problems are therefore complex. An air purification system must be capable of providing atmosphere constituents which are required by the human physiological process and also of removing harmful contaminants. In practice, this requires that oxygen is replenished and that carbon dioxide, carbon monoxide, hydrogen, Freons, vapors and aerosols are removed. Techniques developed for these purposes in submarines may well have application in a spacecraft. ESA

N92-25893*# Applied Sciences Consultants, Inc., San Jose, CA.

MATHEMATICAL MODELING OF CONTROL SUBSYSTEMS FOR CELSS: APPLICATION TO DIET

AHMAD WALEH, THOI K. NGUYEN, and VALERY KANEVSKY /In ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 p 501-505 Dec. 1991

(Contract NAS2-13260)

Copyright Avail: NTIS HC/MF A24; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

The dynamic control of a Closed Ecological Life Support System (CELSS) in a closed space habitat is of critical importance. The development of a practical method of control is also a necessary step for the selection and design of realistic subsystems and processors for a CELSS. Diet is one of the dynamic factors that strongly influences, and is influenced, by the operational states of all major CELSS subsystems. The problems of design and maintenance of a stable diet must be obtained from well characterized expert subsystems. The general description of a mathematical model that forms the basis of an expert control program for a CELSS is described. The formulation is expressed in terms of a complete set of time dependent canonical variables. System representation is dynamic and includes time dependent storage buffers. The details of the algorithm are described. The

steady state results of the application of the method for representative diets made from wheat, potato, and soybean are presented. ESA

N92-25894# Empresarios Agrupados, Madrid (Spain).
ECOSIM: AN ENVIRONMENTAL CONTROL SIMULATION SOFTWARE

R. PEREZ, V. TORROGLOSA, A. LEBRU, and M. NOVARA (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) / In ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 p 507-513 Dec. 1991
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The capabilities of the ECOSIM software, primarily intended to simulate Environmental Control and Life Support (ECLS), are discussed. It may be also customized to the simulation of passive and active thermal control systems, power systems, and more generally any system which can be described as a set of interconnected physical components. ECOSIM will provide a powerful continuous simulation language, a graphical user interface and a library of ECLSS custom made components. The major aims of the development are reviewed and the basic end aspects, i.e., the simulation language and the graphical user interface, are presented though examples aiming at enhancing their understanding. ECOSIM version 1, to be released in 1992, will provide capabilities for simulating air management systems of the degree of complexity encountered in the Hermes and Columbus projects. ESA

N92-25895# Erno Raumfahrttechnik G.m.b.H. Bremen (Germany, F.R.).

TRACE GAS CONTAMINATION CONTROL (TGCC) ANALYSIS SOFTWARE FOR COLUMBUS

H. P. HAFKEMEYER / In ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 p 515-520 Dec. 1991

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In pressurized habitable environments, the respirable atmosphere is contaminated by gaseous trace contaminants generated by off gassing from materials and surfaces, by leakage from pressurized systems and by metabolic processes of crew members and living organisms or from experiments. These contaminants might be removed from the atmosphere by control hardware like filters, adsorbers or catalytic oxidizers in order to control the toxical hazards. For the numerical analysis and simulation of trace gas generation and removal processes within pressurized Columbus elements, the development of a Trace Gas Contamination Control (TGCC) analysis software was initiated. The conceptual design and performance is outlined, with emphasis laid upon an input scheme compatible with ESABASE. ESA

N92-25896# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).

SIMTAS: THERMO- AND FLUIDDYNAMIC SIMULATION OF COMPLEX SYSTEMS

RALF SIMON and JENS EICKHOFF / In ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 p 521-527 Dec. 1991

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In the course of the development of new environmental control and fuel cell systems for the European manned space flight program the thermophysical simulation is getting increasing importance for the assistance and verification of engineer's decisions. Also in the area of the chemical and environmental technologies increasing complexity of systems requires more and more powerful tools for their simulation. To satisfy the requests for a powerful and versatile simulation, a modular thermophysical system simulation package, called SIMTAS was developed. It is designed to meet the special requirements of practical engineering and is based on state of the art software technologies. The

technical capabilities of the simulation program and some examples for its application in actual aerospace programs are described. ESA

N92-25899*# Boeing Aerospace Co., Huntsville, AL. Missile and Space Div.

G189A MODELLING OF SPACE STATION FREEDOM'S ECLSS
 ROBERT S. BARKER and ROGER VONJOUANNE / In ESA, 4th European Symposium on Space Environmental Control Systems, Volume 1 p 541-550 Dec. 1991
 (Contract NAS8-50000)

Copyright Avail: NTIS HC/MF A24; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 150 Dutch guilders (2 vols)

The following are reviewed: the requirements and design of the Environmental Control and Life Support System (ECLSS) for Space Station Freedom; a review of the G189A ECLSS computer program model developed for the complete configuration of pressurized elements or volume; and some significant computed results from this model showing transient performance for subsystems responsible for temperature and humidity control, atmosphere control and supply, air revitalization, and water recovery and management. The computed results presented are important in assessing the capabilities of the ECLSS equipment in maintaining acceptable levels of temperature, humidity, O₂, N₂, and CO₂ in the occupied volumes during crew changeout events. These events involve up to four extra crew members from the orbiter being located temporarily in the Space Station modules in addition to the normal contingent of four crew members. These additional crew members impose additional demands on the ECLSS equipment, in order to control the levels of the aforementioned quantities. Satisfactory control of all these quantities was achieved. The maximum computed pp CO₂ was in the acceptable degraded performance regime. This level is higher than the 3.00 mm Hg upper limit for normal conditions. ESA

N92-25961*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

NUTRITIONAL REQUIREMENTS FOR SPACE STATION FREEDOM CREWS

HELEN W. LANE, BARBARA L. RICE, and CHRISTINE F. WOGAN, ed. (Krug Life Sciences, Inc., Houston, TX.) Washington Jun. 1992 15 p Panel held in Houston, TX, 4-5 Feb. 1991
 (NASA-CP-3146; S-672; NAS 1.55:3146) Avail: NTIS HC/MF A03

The purpose of this report was to set preliminary nutritional requirements for crewmembers flying from 90 to 180 day missions on Space Station Freedom. Specific recommendations included providing crewmembers with in flight feedback on nutritional intake, weight and strength, and incorporating issues of energy intake, body weight, body composition, strength, and protein intake in the flight medicine program. Exercise must be considered an integral part of any plan to maintain nutritional status, especially those modes that stress the skeleton and maintain body weight. Nutrient intake, amount of exercise, and drugs ingested must be recorded daily; high priority should be given to development of fully automated record systems that minimize astronauts' effort. A system of nutritional supplements should be developed to provide a method for reducing intake deficits that become apparent. Finally, post flight monitoring should include bone density, muscle mass and function, and iron status at three and six months after landing. Author

N92-26025# Brookhaven National Lab., Upton, NY.
COMPUTER-BASED DIAGNOSTIC MONITORING TO ENHANCE THE HUMAN-MACHINE INTERFACE OF COMPLEX PROCESSES

I. S. KIM Feb. 1992 14 p Presented at the 8th Power Plant Dynamics, Control and Testing Symposium, Knoxville, TN, 27-29 May 1992
 (Contract DE-AC02-76CH-00016)
 (DE92-011545; BNL-47229; CONF-920538-12) Avail: NTIS HC/MF A03

There is a growing interest in introducing an automated, on-line,

diagnostic monitoring function into the human-machine interfaces (HMI's) or control rooms of complex process plants. The design of such a system should be properly integrated with other HMI systems in the control room, such as the alarms system or the Safety Parameter Display System (SPDS). A conceptual foundation for the development of a Plant-wide Diagnostic Monitoring System (PDMS) is presented along with functional requirements for the system and other advanced HMI systems. Insights are presented into the design of an efficient and robust PDMS, which were gained from a critical review of various methodologies developed in the nuclear power industry, the chemical process industry, and the space technological community. DOE

N92-26158# Naval Training Systems Center, Orlando, FL.
NIGHT VISION GOGGLE SIMULATION Final Technical Report, 1988-1990

RICHARD C. HEBB Oct. 1991 20 p
 (AD-A245745; NAVTRASYSCEN-TR-92-001) Avail: NTIS HC/MF A03

The use of Night Vision Goggles (NVGs) has increased dramatically and so has the number of accidents attributed to NVG aided flight. The work performed under this project represents an investigation of the use of Night Vision Goggles and the exploration of a method for providing simulation of night vision imagery in an interactive flight simulator environment. The characteristics of the Aviators Night Vision (ANVIS) Goggles were investigated and are summarized. A helmet mounted display concept was developed and a testbed was developed. A commercially available magnetic tracking device was obtained to provide head tracking, and, through a in-house designed interface, was interfaced to a SEL flight computer and various image generators. A Z-transform based predictive algorithm for compensating for the throughput delay image effects of a head tracker, flight computer, and image generator was developed and also integrated into the testbed for evaluation. The helmet display NVG concept represents a good alternative to full up flight simulators of the Weapons Tactics Trainers (WTT) type, and could provide significant enhancements to classroom and on the job training. A part task trainer could be developed using the helmet mounted NVG concept that would bridge the gap between classroom and flight. GRA

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SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

A92-39422

COSMIC RAY MODIFICATION OF ORGANIC COMETARY MATTER AS SIMULATED BY CYCLOTRON IRRADIATION

R. I. KAISER and K. ROESSLER (Kernforschungsanlage Juelich GmbH, Federal Republic of Germany) (Modelling, simulation and sounding of cometary nuclei; Proceedings of the International Workshop, Cagliari, Italy, May 28-30, 1991. A92-39408 16-12) Annales Geophysicae (ISSN 0992-7689), vol. 10, no. 3-4, Mar.-Apr. 1992, p. 222-225. refs
 Copyright

Frozen CH₄ and CH₄/Ar mixtures were irradiated with 18 MeV protons and 17 MeV ³He(2+) ions at 15 and 77 K in order to simulate the interaction of cosmic rays with solid organic matter in comets. Solids, sealed into cuvettes, represented the interior of comets, those condensed onto cold finger ice surfaces. C₂H₂ and C₂H₄ were the primary volatile products and were converted to C₂H₆, and heavier hydrocarbons containing up to 28 carbon atoms, by increasing the radiation dose. The release of hydrogen from open ice layers is reflected in a lower H:C ratio and increased carbonization of the residues, as compared to closed targets which yield higher annulated products such as PAH. Author

N92-24323*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
USING SINGLE BUFFERS AND DATA REORGANIZATION TO IMPLEMENT A MULTI-MEGASAMPLE FAST FOURIER TRANSFORM

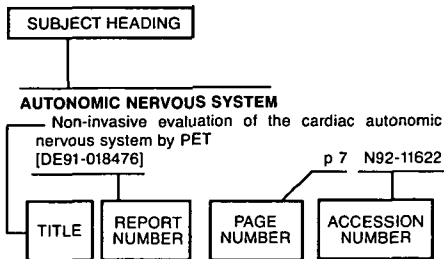
R. D. BROWN *In its* The Telecommunications and Data Acquisition Report p 294-306 15 Feb. 1992

Avail: NTIS HC/MF A14; 13 functional color pages CSDL 06L

Data ordering in large fast Fourier transforms (FFT's) is both conceptually and implementationally difficult. Described here is a method of visualizing data orderings as vectors of address bits, which enables the engineer to use more efficient data orderings and reduce double-buffer memory designs. Also detailed are the difficulties and algorithmic solutions involved in FFT lengths up to 4 megasamples (Msamples) and sample rates up to 80 MHz.

Author

Typical Subject Index Listing



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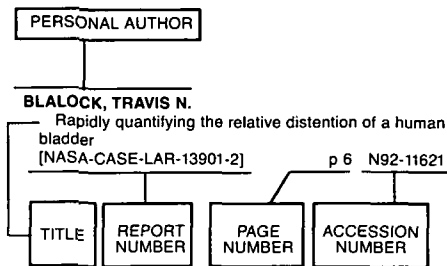
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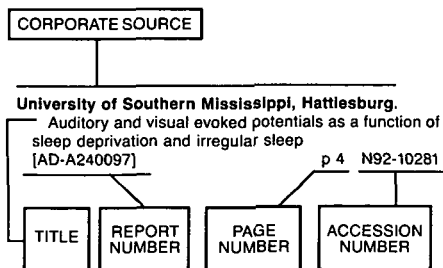
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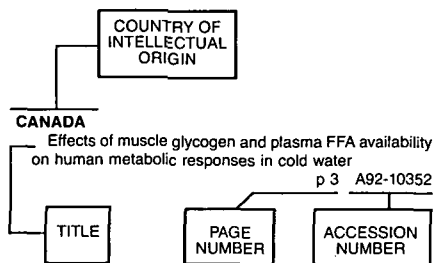
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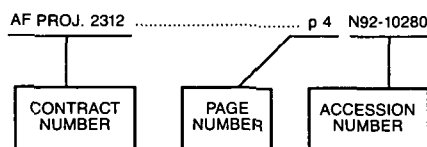
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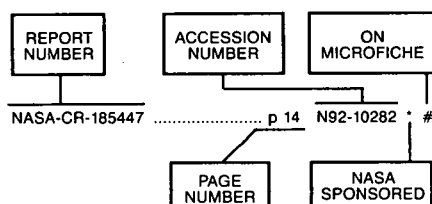
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REPORT

September 1992

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